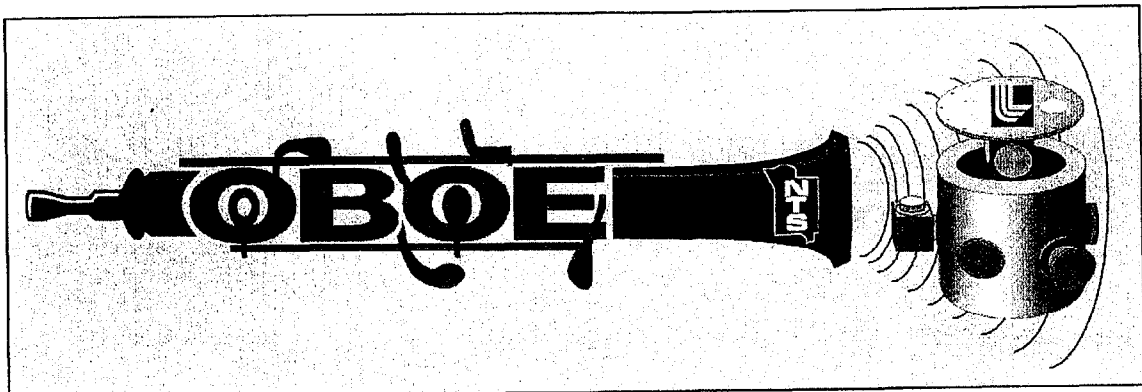


Containment Prospectus for the

OBOE Experiments



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Introduction

OBOE is a series of dynamic subcritical experiments intended for execution in the U1a.102C drift of the U1a complex at the Nevada Test Site (NTS) (Figure 1). The data from the OBOE experiments will be used in the Stockpile Stewardship Program to assess the aging of nuclear weapon components and to better model the long-term performance of the weapons in the enduring stockpile.

The OBOE series of experiments presents a new fielding concept for LLNL subcritical experiments. An experimental alcove will be reused for many different experiments. Each individual experiment will be conducted within a steel experimental vessel. After each experiment, the vessel will be moved to the back of the alcove and entombed in grout. The alcove is designed with sufficient space to entomb 12 experiment vessels.

Each experiment in the OBOE series of experiments is composed of one experimental package. Each experimental package will have high explosive (HE) and special nuclear material (SNM) in a subcritical assembly. Each experimental package will be placed in a steel experimental vessel within the OBOE zero-room. Each experiment will be detonated inside its experimental vessel in the OBOE zero-room that is formed by a steel and concrete barrier at the entrance to the U1a.102C drift.

The containment plan for the OBOE series of experiments utilizes a two containment vessel concept. The first containment vessel is formed by the primary containment barrier that seals the U1a.102C drift. The second containment vessel is formed by the secondary containment barrier in the U1a.100 drift. While it is likely that the experiment vessel will contain the SNM from an experiment, the containment plan for the OBOE series only assumes that the steel experiment vessel provides shock mitigation and is a heat sink for the heat produced by the detonation of the HE. It is possible that one or more of the experimental vessels may seep SNM in the zero-room from a failure of a seal on the vessel.

We are presenting a containment plan for the entire series of OBOE experiments. At this time, we do not know exactly how many experiments will actually be conducted in the OBOE series. However, we do know that the maximum number of experiments in the OBOE series is 12. After the final experiment in the OBOE series, a larger experiment will be conducted in the U1a.102C alcove. This experiment will not be part of the OBOE series and a separate containment plan will be presented to the CRP for this experiment.

We do not intend to present individual containment plans for each experiment of the OBOE series as long as each experiment falls within the parameters given in this document. If an experiment in the OBOE series falls outside the parameters given in this document, a containment plan for that experiment will be presented to the CRP for a full review.

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Experiment Description

Each experiment in the OBOE series will have a single assembly of chemical HE and SNM. This assembly will be put inside an experiment vessel in the zero-room. The HE limit for an individual experiment in the OBOE series operating under this containment plan is 65 grams of LX-14 or its energy equivalent. The experimental vessel will be placed approximately 8 feet from the primary containment barrier in the zero-room.

The essential containment features for each OBOE experiment are:

1. HE weight is limited to a maximum of 65 grams of LX-14 (or its equivalent).
2. Two nested containment vessel concept as defined will be fielded.
3. Each experimental package will utilize an experimental vessel in the OBOE zero-room.

The diagnostics data from the experiment may be recorded either inside or outside of the zero-room depending upon the experimental configuration. Some data may be transmitted over electrical or fiber-optic cables to recording instrumentation outside the zero-room. Other data may exit the zero-room through optical viewing ports. Some data may be recorded on film within the zero-room. The diagnostics may change on each experiment in the OBOE series.

Containment Objective and Goal

The LLNL containment objective for the OBOE experiments (and for all LLNL subcritical experiments) is to assure that no SNM will be released to any uncontrolled environment as a result of the experiment. The specific OBOE containment goal is to confine all SNM to the zero room and/or the alluvium surrounding the zero room.

The OBOE containment design will use the time-tested concept of two nested containment vessels to assure this objective. The first containment vessel (Vessel #1) includes the zero-room in the U1a.102C drift, the primary containment barrier, and the alluvium surrounding the zero-room. The second containment vessel (Vessel #2) includes the volume of Vessel #1, the volume of the U1a.100, U1a.101, and the U1a.102 drifts inside the secondary containment barrier, the secondary containment barrier, and the alluvium surrounding these drifts. Figure 2 illustrates the two containment vessels.

Each experiment in the OBOE experiment series will be conducted within an experiment vessel which will be installed in the zero-room. After an experiment in the OBOE series, the zero-room may be re-entered to gather diagnostics data and then to position another experiment vessel in the zero-room in preparation for another experiment in the OBOE series. An expended experiment vessel will never leave the zero-room; it will be entombed in grout in the zero-room. Therefore, if the OBOE containment goal is achieved, no SNM would ever leave Containment Vessel #1.

The primary containment barrier, the fibercreted walls of the zero-room, and the alluvium on the face of the zero-room will be used to contain any SNM that might seep from an experimental vessel. While we expect that the experiment vessel, by itself, is sufficient to contain the SNM, it would not be unexpected if occasionally an experiment vessel would seep. We expect that any SNM that seeped from an experiment vessel would remain in the zero room or on the surfaces of the zero room walls. The primary containment barrier should see no shock or gas pressure during the OBOE experiment series. The primary barrier has been designed to contain the OBOE series of experiments without the shock and gas pressure mitigation provided by the experiment vessel. The primary containment is essentially a copy of the design used for HOLOG, BAGPIPE, and CLARINET. It is capable of containing HE loads considerably greater than will be used in the OBOE series of experiments. We fully expect that no SNM will be released into the diagnostics rooms outside the primary containment barrier.

The secondary containment barrier in the U1a.100 drift will protect the rest of the U1a complex from contamination if the primary containment barrier fails to provide containment. This is extremely unlikely in the OBOE experiment series since the primary containment barrier will see no shock or gas pressure. The secondary barrier has been designed to fully contain the HE gases and SNM debris, assuming that the primary containment barrier and the experiment vessel do not exist.

The two nested containment vessels provide assurance that the LLNL OBOE containment objective (i.e. no SNM will be released to any uncontrolled environment as a result of the OBOE experiment) will be achieved.

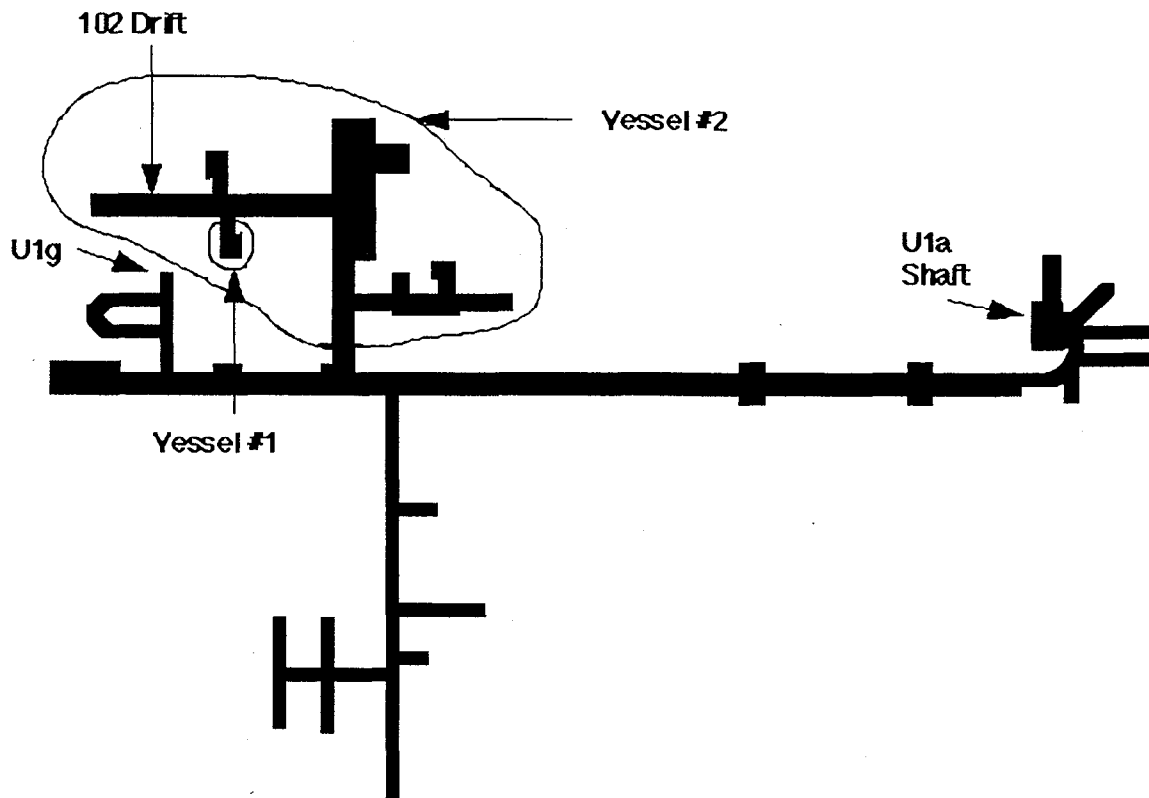


Figure 2. Two nested containment vessels assure that no SNM will be released to any uncontrolled environment.

Geology

Descriptions of the geologic setting and physical property measurements for the U1a complex have been reported in several documents (Drellack et. al., 1989; Allen, 1995; Allen, 1996; Allen, 1998). Mapping, photography and sampling documented the LLNL drifts and rooms as mining progressed in the U1a.102 drift (Allen, 1999). In summary, the alluvium in and around the OBOE zero-room consists of inter-fingered sands, gravels, and cobbles; the alluvium is similar to that found elsewhere in the U1a complex, including the LEDOUX, KISMET, HOLOG, REBOUND, STAGECOACH, CIMARRON, BAGPIPE, and CLARINET zero-rooms.

Figure 3 shows the location of faults around the OBOE zero-room in the U1a.100 drift complex. A fault was seen in the face of OBOE zero-room. This fault is tight; the fault is filled with fault gouge. A nearly vertical fault with no vertical offset (minor slickensides) was found in the heading side of the right rib keyway notch cut for the OBOE barrier. This fault is tight and filled with carbonate cement; no open aperture was observed. It is thought to be a minor splay or en-echelon feature of the previously mapped fault which cuts through the U1a.100 drift. No gravel or boulder channels were found in the mining of the OBOE zero-room. In general, all faults are tight, with no open aperture. Detailed geology (lithology) of the U1a.102C drift (OBOE zero-room) is shown in Appendix 1.

The permeability of the alluvium has been measured in several places within the U1a complex. The typical values for the permeability range between 1-5 darcies. We expect that the OBOE zero-room permeability will be similar to that of HOLOG, BAGPIPE, and CLARINET based upon the similarity in the geology and upon the results of the pressure tests of the primary barrier.

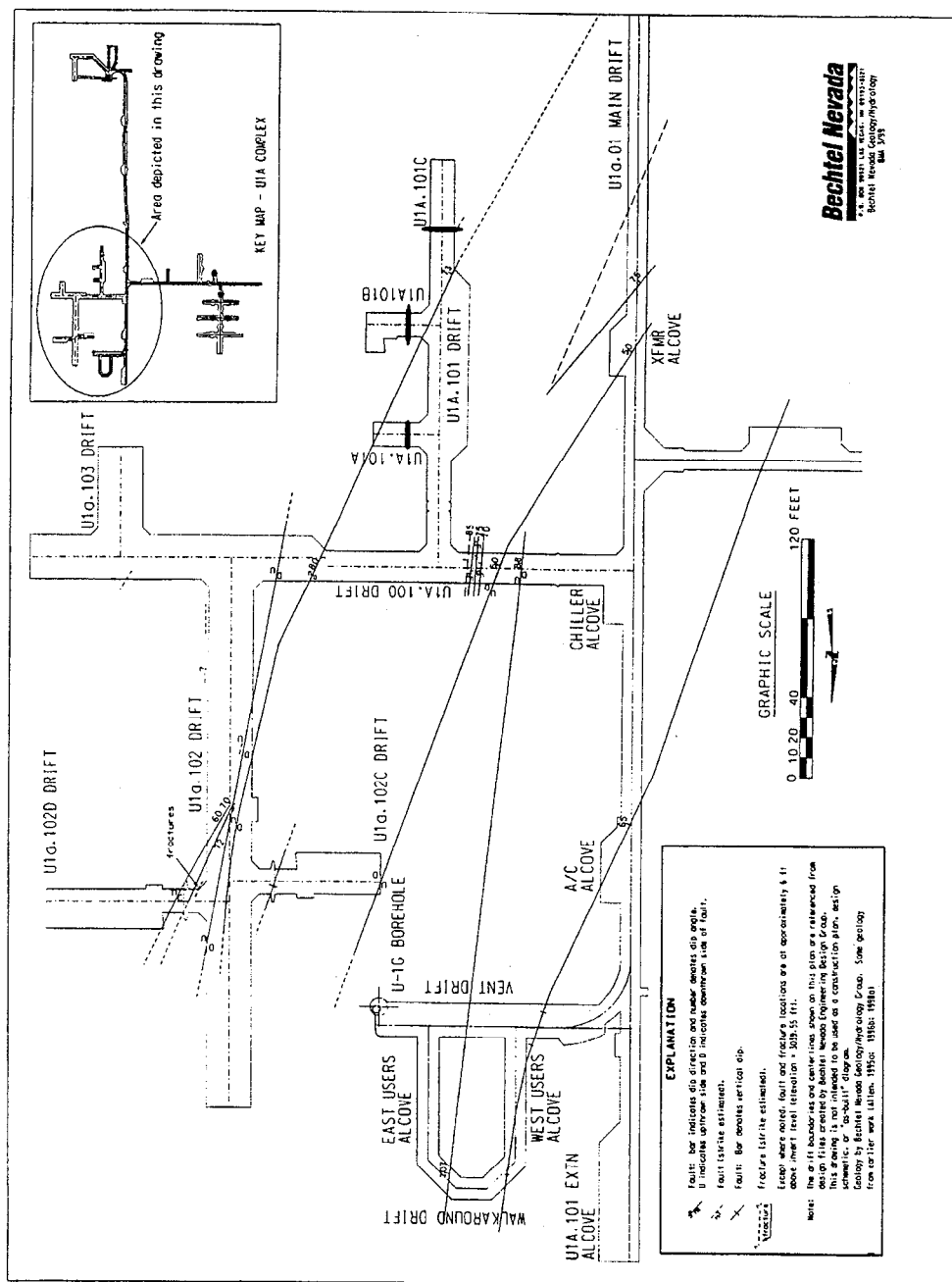


Figure 3. Faults in the U1a.100 portion of the U1a complex.

Experiment Vessel

The OBOE experiment series will use experiment vessels. A vessel will be placed in the zero-room during the experiment setup and the experimental package will be sealed in the experiment vessel. After the experiment has been executed, the experiment vessel will be moved to the rear of the experiment alcove and entombed in grout. A vessel containing an expended experiment will never leave the zero-room. The OBOE alcove was designed with sufficient space to entomb 12 experiment vessels.

The design and testing of the experiment vessels has been thoroughly documented in three separate internal LLNL documents (References 12, 13, 14). For brevity, this section summarizes the design, analyses and testing that LLNL has done on the experiment vessels.

An experiment vessel will be about 42 inches tall and 36 inches in diameter. The initial vessel will be fabricated from steel pipe. Future vessels will probably be cast stainless steel. Appendix 2 contains the engineering drawings for the vessels constructed from steel pipe. The various openings in the vessel are standardized and will be closed with different types of fixtures which bolt to the flanges on the vessel's openings. The fixtures are sealed to the flanges with a double O-ring assembly. The type of fixture bolted to a specific flange depends upon the diagnostic requirements for the experiment and experimental setup inside the vessel.

The experiment vessel design was finalized after DYNA computer simulations of shock dynamics on proposed designs. The computer analyses indicated that the lids of the vessel are the limiting factor in the design of the steel vessel. The lids are made from 50 ksi steel; the static tests suggest that the yield pressure for the lid would be about 850 psi. The design work included design of penetration assemblies for different diagnostic configurations. Vessel testing included a number of static and dynamic tests. A prototype vessel was built and tested in the High Explosive Assembly Facility (HEAF) at LLNL. We studied the performance of all penetrations; specifically we examined whether cable feedthroughs had leakage, whether the O-ring seals on glass windows were tight, and whether glass windows would survive.

Dynamic testing was done using a series of C4 explosive balls. Holography fixtures that incorporate glass windows were used on the flanges of the vessel during this testing. The same glass windows were used in the experiment vessel ports for all tests. All windows survived until the charge size was the equivalent of 454 grams of LX-14 explosive. At this charge size, some of the windows which had been pitted with shrapnel from the earlier smaller tests broke. This HE charge is approximately 7 times the OBOE HE limit of 65 grams of LX-14. We also examined whether the vessel would "contain" the HE gas products. At a charge size of 227 grams, we detected leakage past the first O-ring in some of the double O-ring seals on the vessel. All of these tests were done with "bare" HE balls; the HE was not in device cube assemblies as it would be during an actual experiment.

Several tests were done with a typical OBOE HE assembly in an actual device cube. In each test, the experiment was fully contained within the vessel. Everything worked as designed. No HE gas was detected anywhere outside of the experiment vessel. No HE gas was detected in the interstitial space between the double O-ring seals. The cable feedthroughs, the O-rings, and the optic windows performed satisfactorily.

The design work and testing give us confidence that the experiment vessel will perform as we intend. It will probably contain each OBOE experiment by itself. However, given the uncertainty in totally predicting the effect of shocks and the actual distribution of shrapnel in small confined spaces, it would not be unexpected if there was a small seep from a vessel during one of the OBOE experiments. This is the reason that we have not designated the experiment vessel as Containment Vessel #1. However, we have total confidence that the experiment vessel will not dynamically fail. The experiment vessel will provide effective shock mitigation (at a minimum) and will probably contain each OBOE experiment.

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Blast and Quasi-Static Gas Pressures

The experimental vessel will mitigate all blast pressures from an experiment so that the primary containment barrier will see no blast pressures. Experiments conducted at the LLNL High Explosive Assembly Facility (HEAF) demonstrate that the experiment vessel will mitigate shock pressures for the OBOE HE limit of 65 grams very effectively.

We expect that the experiment vessel will contain any quasi-static gas pressure produced by the HE detonation products. During the experiments, the experiment vessel will be evacuated. The BLASTX code, Version 3.6.3 (Britt and Lumsden, 1994), was used to estimate the quasi-static gas pressure in the experiment vessel. Results indicate that following an initial short-lived shock from the experiments, a quasi-static gas pressure of about 25 psia would be formed. Due to thermal conduction, the pressure would rapidly fall and be sub-atmospheric (~ 14 psia) within about 0.5 second. In about 2.5 seconds, the gas pressure in the experiment vessel would have fallen to less than 2 psia.

A complete and total failure of the experiment vessel would result in a slight reduction of the ambient pressure in the zero-room after 0.5 second. Air would then be drawn out of the alluvium surrounding the zero-room through the filter wall on the face of the zero-room.

OBOE cannot produce any positive quasi-static pressure on the secondary containment barrier. A primary containment barrier failure might produce a very negligible negative pressure at the secondary containment barrier. Again, air would be drawn from the alluvium surrounding the drifts to eliminate the negative pressure.

It is essentially impossible for the OBOE experiments to produce a positive quasi-static gas pressure on either containment barrier.

Primary Containment Barrier

The primary containment barrier is the structure in the U1a.102C drift which "seals" the drift forming the zero-room. This barrier is a duplicate of the primary containment barriers used for the BAGPIPE and CLARINET experiments with only a few minor modifications.

The OBOE primary containment barrier was constructed from steel I-beams, 1 inch steel plate, and fibercrete. The primary barrier was firmly attached to the drift walls by a grout keyway and to a steel pedestal captured by grout under the drift invert. The drift invert was covered with six inches of concrete. The penetrations through the primary containment barrier include a 42 inch I.D. manway (crawl tube), six 16.38 inch optical LOS pipes, and one airline/grout tube. There are no other penetrations through the primary containment barrier. The main drawings for this barrier are included in the Appendix 3.

The 42 inch manway will be secured prior to detonation using two Class 75-TB closures. These closures are rated for 175 psig at 250 °F. On BAGPIPE and CLARINET, we used a modified closure for the inner closure on the manway. For OBOE, the manway with the two closures has been built as a unit by the manufacturer with the inner closure designed to be closed from the inside of the tube. The manway system is being used in its rated condition. We believe that this will provide a greater assurance that the manway will perform as rated.

The six optical LOS pipes may be used to transmit optical diagnostics data from the zero-room to the diagnostic recording equipment on the other side of the primary containment barrier. The optical LOS pipes which do not have optical window assemblies will have blind flanges on both sides of the barrier. Minor modifications have been made to the optical LOS pipe design when compared to the BAGPIPE and CLARINET optical LOS pipes. The details of the modified design will be discussed in a later section.

The airline/grout tube was constructed from 10 inch Schedule 60 pipe. During an experiment, the 10 inch tube will be closed on the WP side of the barrier with a 10 inch butterfly victaulic valve rated at 300 psi; the portal side of the tube will be closed with a blind flange.

All seams in the one inch steel plate are continuously welded. The crawl tube, the optical LOS pipe assemblies, and the airline/grout line are continuously welded to the 1 inch steel plate. The steel plate was spot-welded to the I-beam structure on the diagnostics room side of the primary containment barrier. All welds were inspected. The pressure integrity of the primary barrier was tested by overpressurizing the zero-room to 2 psig. Any leaks in the weld discovered during this pressurization test were rewelded and then retested.

All welds on the zero-room side of the 1 inch steel plate were covered with Gluvit™. This material is a waterproof epoxy sealer. It is commonly used to seal leaky rivets on aluminum and steel ships. The Gluvit™ moves with the ship's hull as it vibrates and flexes and does not part from the members to which it is bonded.

When used to seal steel ship hulls, a 10 mil coat will withstand greater than 4000 lbs per sq. ft. water pressure (~28 psi).

The barrier is attached to the alluvium via a grout keyway that securely fastens the barrier to the formation. A 2.5 foot wide steel channel (part of which is formed by the 1 inch steel plate) was secured by rockbolts to the formation behind the keyway to secure. The keyway is approximately 2.5 feet side and 4 foot deep. The grout pipes in the keyway were carefully monitored to insure a complete fill of the grout ring with grout. After the grout had set up for 28 days, the other grout pipes in the grout ring were used to pressure grout around the keyway grout ring. Pressure grouting should fill any voids in either the alluvium or voids that might have formed at the interface between the keyway grout ring and the alluvium. That being the case, the absolute minimum unimpeded path length through the alluvium around the primary containment barrier exceeds 8 feet.

Finally, fibercrete was applied in a minimum thickness of six inches in two 3 inch passes over the primary containment barrier, the exposed portion of the keyway, and the zero-room walls. This is done **before** the invert is poured in the zero-room. In essence, we are forming a fibercrete "bottle" in the zero-room whose opening is on the face of the zero-room. A dense pattern of 1/2" dia five inch long Nelson studs were welded to the steel plate before fibercreting to help secure the fibercrete to the steel plate and prevent spalling of the fibercrete after detonation.

The primary containment barrier, while designed by Bechtel Nevada and LLNL structural engineers to withstand blast pressures, will not see any blast pressures during the OBOE series of experiments since the experiment vessel will provide effective blast mitigation. Dynamic and static analyses have been conducted on the design including individual components of the design. These analyses were reported to the Containment Review Panel during the BAGPIPE presentation and in the BAGPIPE Prospectus. The steel used in barrier construction has been tested and inspected to assure that the steel meets specifications. From a containment viewpoint, structural failure of the primary containment barrier during the OBOE series of experiments is not a credible event.

As a final containment measure, the diagnostics room side of the primary containment barrier will be covered with Versi-Foam™. The foam will act as the final containment barrier for plutonium particulates. The foam should encapsulate any particulates that might seep out. We view the possibility of seepage as extremely unlikely since there will be essentially no quasi-static gas pressure in the zero-room; however, with the amount of expensive diagnostics equipment in the diagnostics rooms, the Versi-Foam™ should be a effective yet inexpensive additional barrier assuring containment within Vessel #1.

Secondary Containment Barrier

A secondary containment barrier (Appendix 4) was constructed in the U1a.100 drift and used on the HOLOG, BAPIPE, and CLARINET experiments. We intend to use this barrier as the secondary containment barrier for the OBOE series of experiments. The tunnel volume between the OBOE primary containment barrier in the U1a.101C drift and the secondary containment barrier in the U1a.100 drift will house the OBOE experiment's diagnostics instrumentation. The secondary containment barrier, the tunnel drift volume between the secondary and primary containment barriers, and the alluvium around the drift form Vessel #2 in the two nested containment vessel concept.

The OBOE series of experiments will produce no pressure on the secondary containment barrier since the experiments will be conducted in sealed experiment vessels placed inside the closed zero-room. However, the secondary containment barrier was designed with a 7.6 psig static design load. This design load was selected during the construction of HOLOG and was based upon the maximum load the barrier would see given a 50 lb HE experiment in the tunnel volume that then existed. The Vessel #2 volume is now considerably larger and the OBOE experiments will be considerably smaller than 50 lb. The volume of Vessel #2 is now approximately 243,000 cubic feet.

No changes have been made to the secondary barrier since it was constructed and used for HOLOG. The details of the secondary barrier design were presented in the HOLOG prospectus and will not be repeated here. We intend to operate this barrier in the same manner as was done for HOLOG.

The following is a short summary of the design and operational features of this barrier:

The secondary containment barrier has a large passageway to allow normal access to the U1a.100 drift complex. These passageways will be sealed by two steel doors that are supported by a late-time beam.

No cables pass through the secondary containment barrier. All cables pass through Vistanex boxes located in the tunnel invert on the working point side of the secondary containment barrier. All cables are either factory gas-blocked or discretely gas blocked in the Vistanex box.

The penetrations through the secondary containment barrier include a hatch (for late-time man access), chilled water lines (for cooling of diagnostics equipment), and ventilation and air lines. The hatch through the secondary containment barrier will allow access to the U1a.100 drift complex during button-up and reentry operations. This hatch will be bolted and gasketed tight during button-up operations. The water lines using for cooling electronic equipment in the diagnostics room will each have two redundant valves to close the water lines before zero-

time. A large tank of chilled water in the diagnostics area will be used to circulate chilled water between the button-up and event reentry. The valves in the water lines will have up-hole readout of the status of valve closure so that the closure of the water lines can be positively assessed from the surface before zero-time. The valves are pressure-rated for 600 psi. The ventilation line through the secondary containment barrier will be interrupted during the button-up operations. The ventilation line will be closed with a blind flange and the butterfly valve in the ventilation line will be closed.

We intend to operate the secondary containment barrier on the OBOE experiments as we did on HOLOG, BAGPIPE, and CLARINET experiments.

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Optical Ports

The primary containment barrier will contain six optical ports (Appendix 3). The number of optical ports used for an OBOE experiment will vary. During any particular OBOE experiment, all ports will contain either two glass window assemblies, or two blind flanges, or one blind flange and one window assembly. The OBOE optical port design follows the optical port design successfully used on HOLOG, BAGPIPE, and CLARINET. The OBOE optical port assemblies follow a pedigree that was documented in the HOLOG prospectus. The fundamental design features of the assembly have been thoroughly field and laboratory tested. For OBOE, there are minor changes to the spool piece into which the optical port assembly is mounted. This was done to facilitate the alignment of the port assemblies during construction.

The optical ports are housed within steel circular housings which are welded into the primary containment barrier (Appendix 5). The OBOE design uses optical port assemblies that are directly mounted to the steel circular housing that is welded into the containment barrier. Each optical port assembly is mounted on a steel circular housing made from 17 inch OD steel pipe with 1.5 inch wall thickness. The optical assembly is bolted to the steel circular housing with twelve bolts using two Buna-N O-rings to seal this connection. Each working optic port in the containment barrier will have two port assemblies.

The optical glass in a port assembly is made from 2 inch thick 9 inch diameter BK-7 glass. The optical glass is supported by two BJB #9 bell jar Buna-N gaskets in the optical port assembly. A Buna-N O-ring supported by two backup rings is used to complete the sealing of the optical glass in the optical port assembly. The window housing and window retainer are now made with aluminum, instead of steel as in previous window assemblies.

The optical port assemblies will be mounted in the primary containment barrier using a procedure which has been written to assure that the o-rings have been properly installed. The assembly procedures follow those developed for HOLOG include optical measurements to determine whether stress concentrations have been induced in the glass during the assembly process.

All optical port assemblies are protected from direct shrapnel impact by the experiment vessel. Optical ports which do not contain optical window assemblies will be covered with blind flanges.

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Containment Vessel #1 and #2 Wall Treatment

The walls of the zero-room and the diagnostics room will be completely covered with fibercrete; the sole exception is a portion of the face of the zero-room. It will not be covered with fibercrete in order to provide the HE gases from a future non-OBOE experiment with a path to porously flow into the alluvium away from the primary containment barrier and reduce any residual gas pressure in the zero-room. The fibercrete will be installed in two passes to minimize or eliminate cracking in the fibercrete. The fibercrete will have a minimum compressive strength of 6000 psi in 28 days.

The fibercreting is being done to help improve drift stability and to reduce the potential of dust contamination for the complicated optical diagnostics which will be fielded on the OBOE experiments. In the zero-room, the fibercrete will be troweled to embed the steel fibers and eliminate the fibers as both a dust collector and a safety hazard. To further reduce the possibility of dust contamination, all of the fibercreted walls will be covered with an elastomeric coating. As a by-product of treating the walls in this fashion to reduce dust contamination, the permeability of the fibercreted walls is reduced from the alluvial permeability of about 2 darcies to a permeability in the milli-darcy range. This helps increase the effective path length for porous flow from the zero-room.

A portion of the face of the zero-room will not be covered with fibercrete. A steel stud wall will be constructed over top portion of the face; the steel stud wall will be covered with a treated fabric (similar to furnace filter material) to reduce dust contamination for the optical diagnostics in the zero-room.

Cable Gas Blocking

No cables pass through the primary containment barrier in the U1a.102C drift or secondary containment barriers in the U1a.100 drift. All cables which exit the OBOE zero-room will pass through Vistanex boxes placed in the tunnel invert. Cables which will also exit the OBOE diagnostics room will pass through Vistanex boxes placed in the tunnel invert just inside the secondary containment barrier. The cable gas blocking techniques used on OBOE closely follow what was successfully utilized on HOLOG, BAGPIPE, and CLARINET. The Vistanex boxes on the OBOE series of experiments will be filled with either Vistanex or Hot Melt, depending upon the availability of either material at NTS at Vistanex box fill time. Hot Melt is a generic substitute for Vistanex. Information about this material was presented to the CRP during the LANL CIMARRON presentation.

All cables will either be factory gas-blocked or discretely gas blocked in the field. The discrete cable gas blocking methods follow conventional underground nuclear testing practices. This includes the use of discrete blocks on multi-conductor cables and "birdcages" on delicate fiber optical cables. All gas blocks are located in the Vistanex boxes in the tunnel invert. Cable separators were installed to physically maintain cable separation in the invert when the cables were captured by the invert concrete pour. Table 1 lists the cable inventory and the type of gas blocking utilized for the cables which exit the OBOE zero-room.

One Vistanex box will not be used during the OBOE experiments. Both ends of the cable conduits leading to this box will be sealed with pipe caps or rated pipe plugs. The lid of this box will be sealed with RTV applied as a sealant and gasket. This box will be used for a future experiment that is not part of the OBOE experiment series.

Table 1

Cable Type (Gas blocking)	Quantity
RF-44 (Factory gas blocked)	66
FO-16 (Factory gas blocked)	1
MP-46 (Field gas blocked – discrete gas blocks)	18
3 Conductor #8 (Field gas blocked – discrete gas blocks)	4
Fiber optic cables (Field gas blocked – 3 birdcages)	52
"C" cables (Field gas blocked – Pressure feedthroughs)	34
Total Number of Cables	175

The OBOE zero-room Vistanex boxes will be placed in the drift invert on the working point side of the primary containment barrier. The Vistanex box itself is of typical DNA design; this typical design has been successfully utilized for many years on horizontal underground nuclear tests and eliminated the transport of gas and/or particulates down the cables and/or cable bundle past the box. The tubes which carry the cables into the Vistanex box will be completely filled with Sulfaset. This helps block the cable bundle and confines the Vistanex to the box. The Vistanex box will be placed below the drift invert on the working point side of the barriers. If gas and/or particulates migrate through the cables to the Vistanex box, the gas and/or particles will be still contained on the zero-room side of the primary containment barrier. The Vistanex box will be filled from the zero-room through two fill tubes to ensure a complete filling of the box. Pipe caps will then be reinstalled on the fill tubes in the zero room.

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Containment Discussion

The containment goal is to keep the SNM from the OBOE experiment contained within Containment Vessel #1. The plutonium will be melted and blown to smithereens inside the experiment vessel. The molten plutonium will react with the high explosive gases producing a solid-phase plutonium aerosol and particulates. Within about 0.5 seconds, the gas pressure inside the experiment vessel will be sub-atmospheric ($< \sim 14$ psia). We expect that the SNM will be fully contained within the experiment vessel. However, it would not be unexpected if an experiment vessel in the OBOE series seeped. Excluding a dynamic failure of an experiment vessel, there is no threat from pressure-driven flow on the OBOE series of experiments, since the experiment vessel will mitigate shock and quasi-static gas pressures produced by the experimental package inside the experiment vessel, and also protect the primary barrier from shrapnel.

The OBOE plan is conservative. Each OBOE experiment uses two containment barriers (identical to those on CLARINET). Each OBOE experiment has less than 1/3 of the CLARINET HE inventory (no HE mirror pads are planned for the OBOE series). In addition, each OBOE experiment will be executed in an experiment vessel which, at a minimum, will provide shock and quasi-static gas pressure mitigation and shrapnel confinement. For most (and maybe all) OBOE experiments, the experiment vessel will fully contain the SNM from the experiment. Precluding a dynamic failure of the experiment vessel, there will be no pressure challenge to the primary (or the secondary) containment barrier.

Containment for each experiment in the OBOE series of experiments is essentially over in seconds or minutes after the experiment. If an experiment vessel seeps, an operational decision will be made as to whether to reuse the OBOE alcove for another experiment. Re-entry into a contaminated zero-room will be conducted according to operational procedures which have been established. In the zero-room, we will have instrumentation to help determine whether an experiment vessel seeped before re-entry begins. However, all initial re-entries will be conducted as though the vessel seeped. The experiment alcove will be thoroughly examined before the resumption of normal activity.

We conclude that the transport of SNM outside Containment Vessel #1 is not a credible threat on the OBOE experiments. In summary, there are redundancies in the design of Containment Vessel #1 that will prevent any SNM from reaching the diagnostics room. We fully expect that the LLNL containment goal (to keep the SNM contained within Containment Vessel #1) will be completely achieved.

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References

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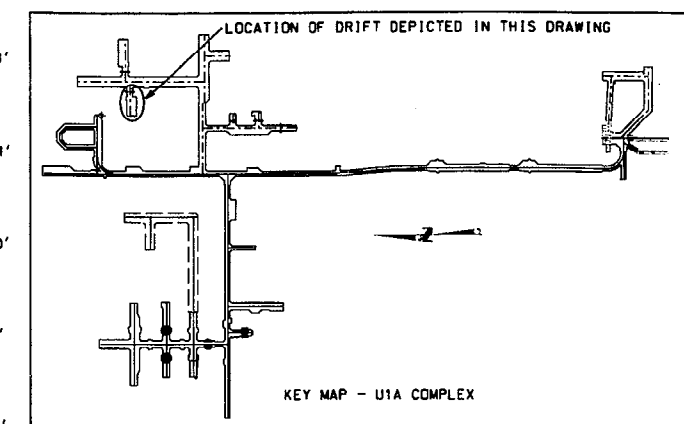
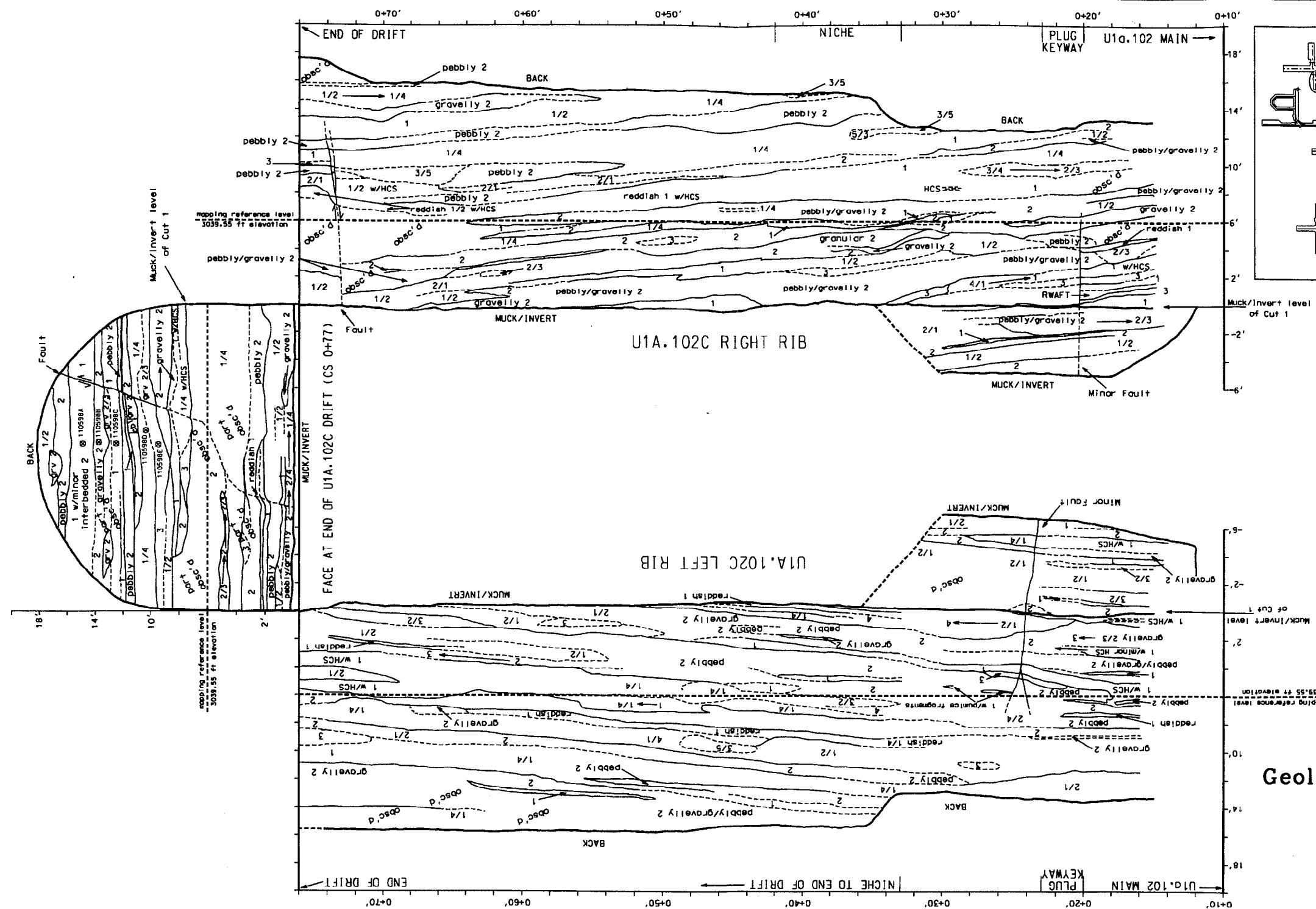
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Appendices

Geology of U1a.102C Drawings	Appendix 1
Experiment Vessel Drawings	Appendix 2
Primary Containment Barrier Drawings	Appendix 3
Secondary Containment Barrier Drawings	Appendix 4
Optical Ports Drawings	Appendix 5

APPENDIX 1

Geology of U1a.102C Drawings



EXPLANATION

- = Bed contact
- - - = Indistinct bed contact
- = Horizontal caliche stringers
- 010599A = Grab sample location and number
- RWAFT = Reworked ash-fall tuff
- AFT = Ash-fall tuff
- obs'd = Obscured drift surface
- Fault: arrows show sense of displacement

Note: See Figure 1 for detailed drift plan. See Table 1 for descriptions of numerical mapping units. Arrows indicate transition/gradation from one unit to another.

GRAPHIC SCALE

0 1 2 3 4 5 10 (ft)

0 0.5 1 2 4 (m)

Geology of the U1a.102C Drift.

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P.O. BOX 98521 LAS VEGAS, NV 89193-8521

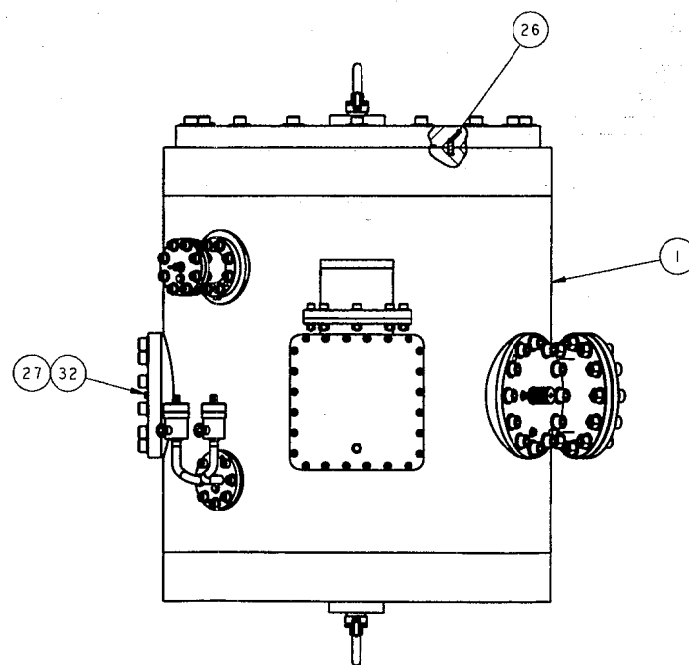
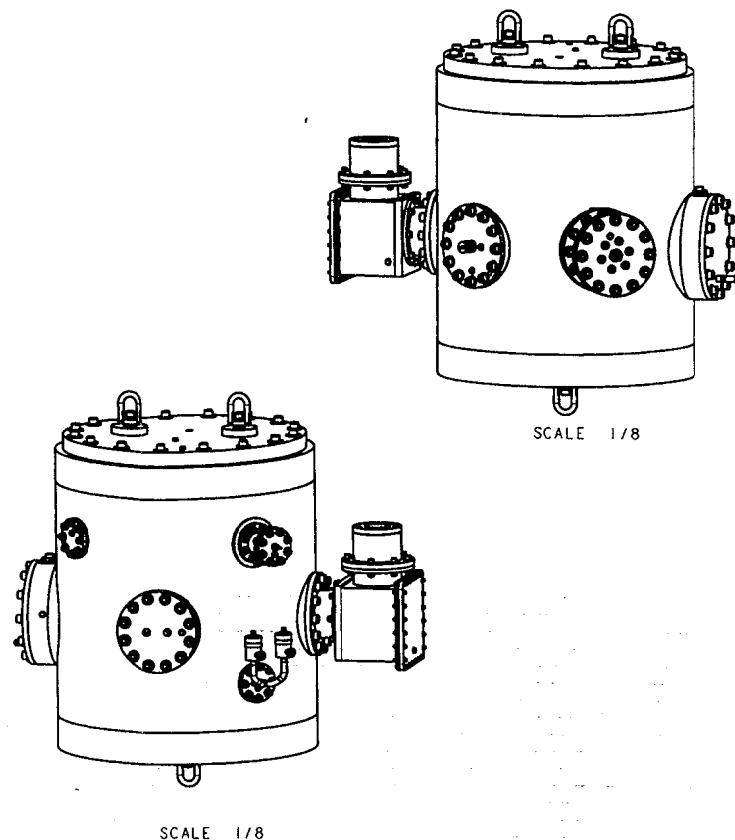
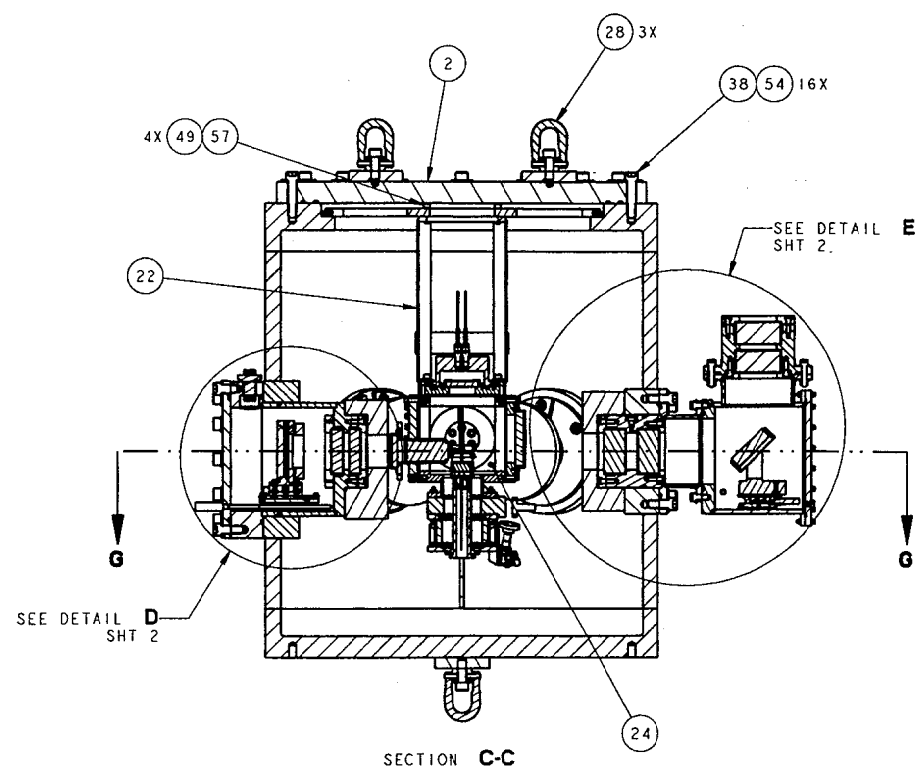
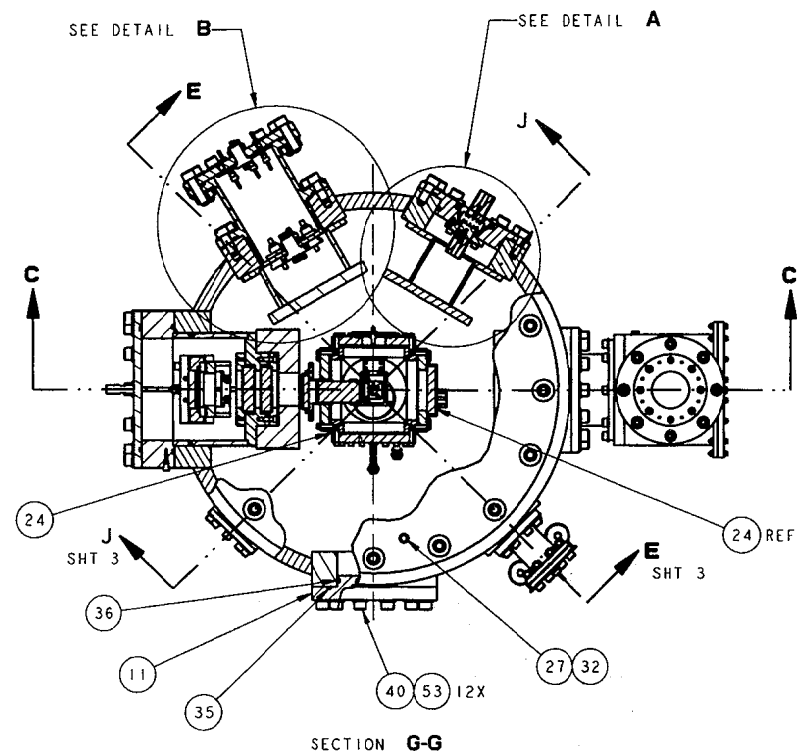
Geology/Hydrology Group

BMA 3/99

APPENDIX 2

Experiment Vessel Drawings

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			CHKD: P. GENNARO				
			APVD: V. BRUGMAN				
			ORIGINAL ISSUE				

8	NUT, .500 NOM	STL	59
2	WASHER, .250 NOM	SST	58
14	WASHER, .375 NARROW	SST	57
48	WASHER, .500 NARROW	STL	56
16	WASHER, .750 NOM	STL	55
60	WASHER, .750 NARROW	STL	54
2	SHCS #10(.180)-32 UNF X .501H	SST	53
2	SHCS .250-20 UNC X 1.50 L	SST	52
6	SHCS .375-16 UNC X 1.00 L	SST	51
4	SHCS .375-16 UNC X 1.50 L	SST	50
4	SHCS .375-16 UNC X 2.00 L	SST	49
8	SHCS .500-13 UNC X 1.25 L GRD 5 STL		48
24	SHCS .500-13 UNC X 1.75 L GRD 5 STL		46
8	HEX HEAD BOLT .500-13 UNC X 2.00 L GRD 5 STL		45
1	SHCS .750-10 UNC X .75 L GRD 5 STL		43
47	SHCS .750-10 UNC X 2.00 L GRD 5 STL		42
12	SHCS .750-10 UNC X 2.50 L GRD 5 STL		41
12	SHCS .750-10 UNC X 2.75 L GRD 5 STL		40
16	SHCS .750-10 UNC X 3.50 L GRD 8 STL		39
1	PARKER SIZE, 2-451 O-RING, 10.975 ID X .275	VITON	38
1	PARKER SIZE, 2-438 O-RING, 6.225 ID X .275	VITON	37
1	PARKER SIZE, 2-445 O-RING, 7.975 ID X .275	VITON	36
1	PARKER SIZE, 5-631 O-RING, 26.408 ID X .275	VITON	35
1	PARKER SIZE, 5-955 O-RING, 28.801 ID X .275	VITON	34
5	PARKER SIZE, 3-904 O-RING, .35 ID X .07	VITON	33
1	PARKER SIZE, 5-800 O-RING, 2.225 ID X .275	VITON	32
1	PARKER SIZE, 5-983 O-RING, 2.975 ID X .275	VITON	31
2	CARR LANE OR EQ. LEVELING LUG, PART# CL-4-ELL		30
3	CARR LANE SWIVEL HOIST RING, CL-5000-SHR-1		29
4	SSP FITTINGS CORP. STRAIGHT THD PLUG, PART#1/4GP	316 SST	28
2	CARR LANE PIN, NO. CL-5-DPZ		27
4	CARR LANE SWIVEL SCREW CLAMP NO. CL-3-SSC STL		26
1	AAA99-100466-00 TEST ASSEMBLY		25
1	AAA99-102332-00 CUBE ISOLATION SPACER		24
1	AAA98-108017-0A EXPERIMENT MOUNTING FRAME, TAB-02		23
1	AAA98-108016-00 WAGON WHEEL		22
1	AAA98-108038-00 FILM HEXCEL		21
1	AAA98-108015-00 FIBER OPTIC SHIELD WELDMENT		20
1	AAA98-108011-00 FIBER OPTIC FEEDTHROUGH ASSEMBLY		19
1	AAA98-108006-00 FILM DIPSTICK		18
1	AAA98-108010-00 FILM INSERT COVER		17
1	AAA98-108005-00 FILM BOX ASSEMBLY		16
1	AAA98-108001-00 MIRROR ENCLOSURE ASSY		15
1	AAA98-107998-00 LASER CARTRIDGE ASSEMBLY, OUTER		14
1	AAA98-107990-00 LASER CARTRIDGE ASSEMBLY, INNER		13
1	AAA98-107988-00 6 3/4 INCH PORT FLANGE		12
1	AAA98-107986-00 2 INCH PORT FLANGE		11
1	AAA98-108020-00 BNC SHIELD WELDMENT		10
1	AAA98-108039-00 LASER HEXCEL		9
1	AAA98-108019-00 BNC FEEDTHRU ASSEMBLY		8
1	AAA99-102327-00 VAC VALVE WELDMENT ASSY		7
1	AAA98-107981-00 DETONATOR BLAST PLATE		6
1	AAA98-107989-00 DETONATOR BLAST TUBE		5
1	AAA98-107985-00 DETONATOR FEEDTHRU ASSEMBLY		4
1	AAA98-107978-00 VESSEL LID, TAB-01		3
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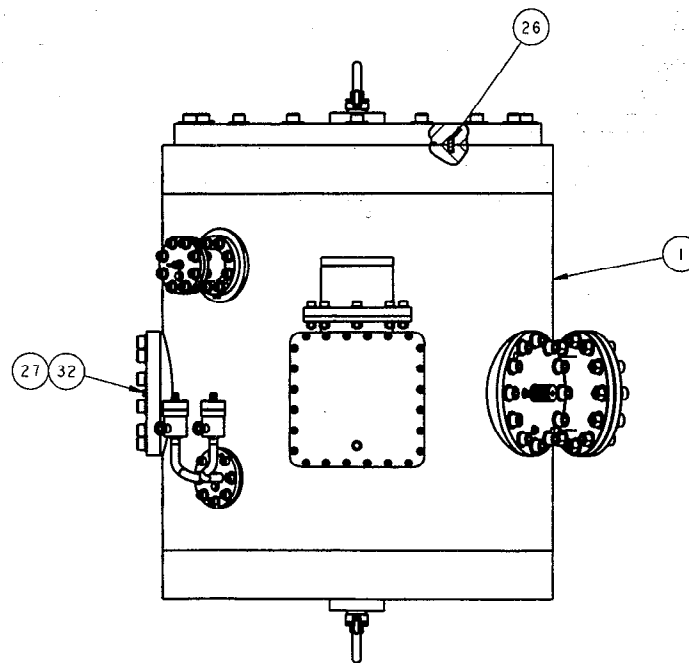
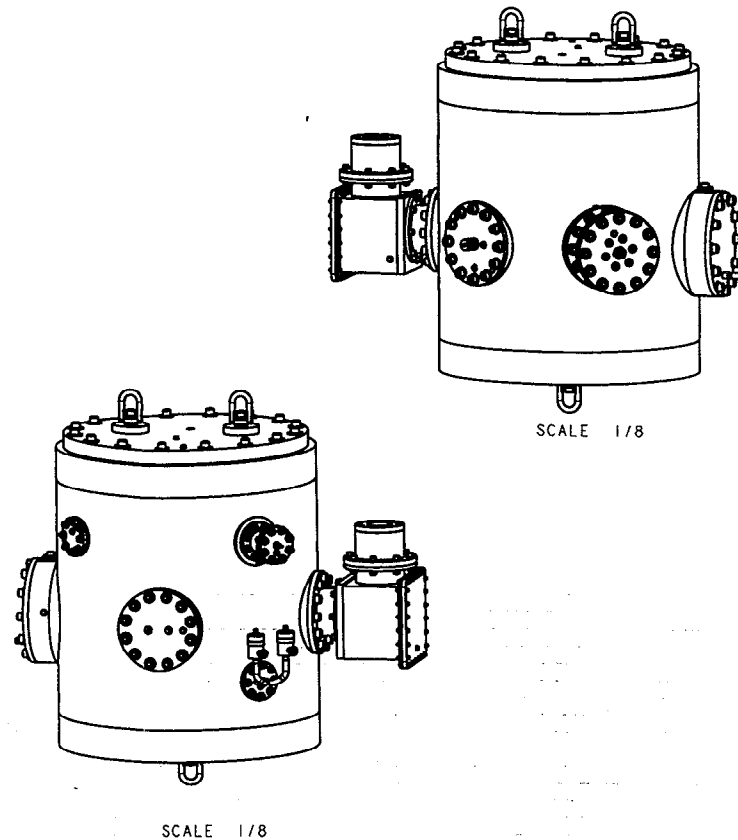
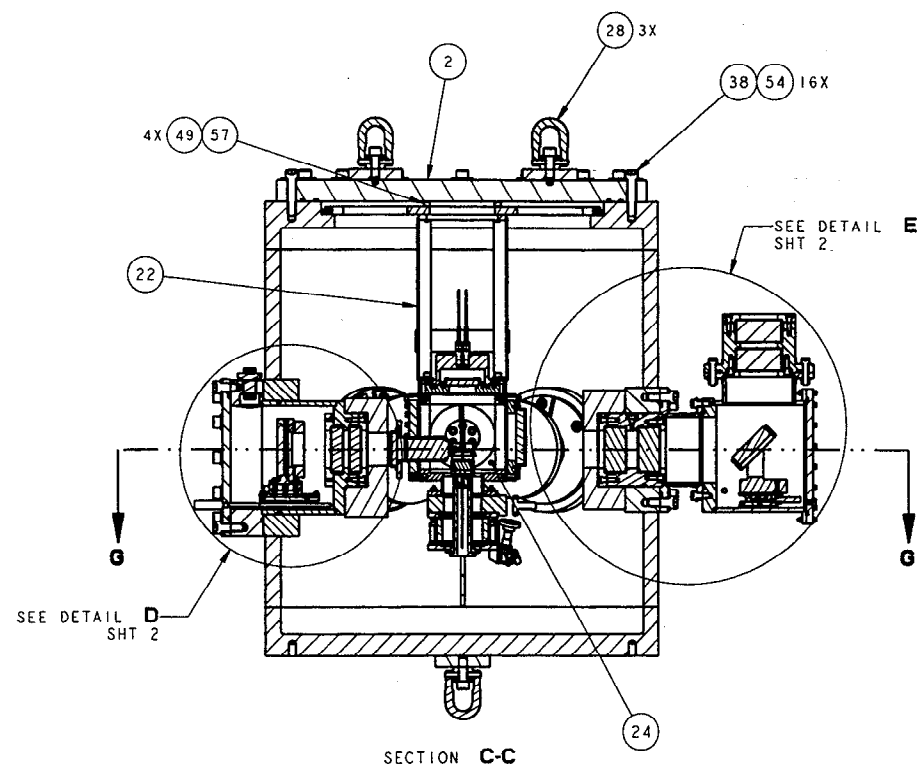
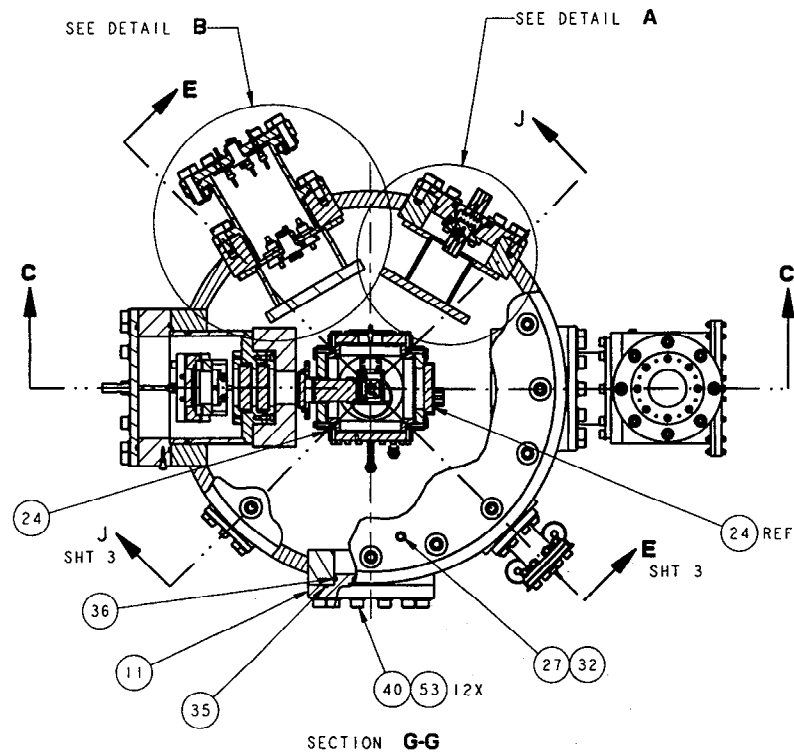
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14	WASHER, .375 NARROW	SST		57
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6	SHCS .375-16 UNC X 1.00 L	SST		50
4	SHCS .375-16 UNC X 1.50 L	SST		49
4	SHCS .375-16 UNC X 2.00 L	SST		48
8	SHCS .500-13 UNC X 1.25 L GRD 5 STL			47
				46
24	SHCS .500-13 UNC X 1.75 L GRD 5 STL			45
8	HEX HEAD BOLT 500-13 UNC X 2.00 L	GRD 5 STL		44
				43
1	SHCS 750-10 UNC X .75 L GRD 5 STL			42
47	SHCS 750-10 UNC X 2.00 L GRD 5 STL			41
12	SHCS 750-10 UNC X 2.50 L GRD 5 STL			40
12	SHCS 750-10 UNC X 2.75 L GRD 5 STL			39
16	SHCS 750-10 UNC X 3.50 L GRD 8 STL			38
1	PARKER SIZE, 2-451 O-RING, 10.975 ID X .275	VITON		37
1	PARKER SIZE, 2-430 O-RING, 6.225 ID X .275	VITON		36
1	PARKER SIZE, 2-445 O-RING, 7.975 ID X .275	VITON		35
1	PARKER SIZE, 5-631 O-RING, 26.408 ID X .275	VITON		34
1	PARKER SIZE, 5-955 O-RING, 28.801 ID X .275	VITON		33
5	PARKER SIZE, 3-904 O-RING, .35 ID X .07	VITON		32
1	PARKER SIZE, 5-800 O-RING, 2.225 ID X .275	VITON		31
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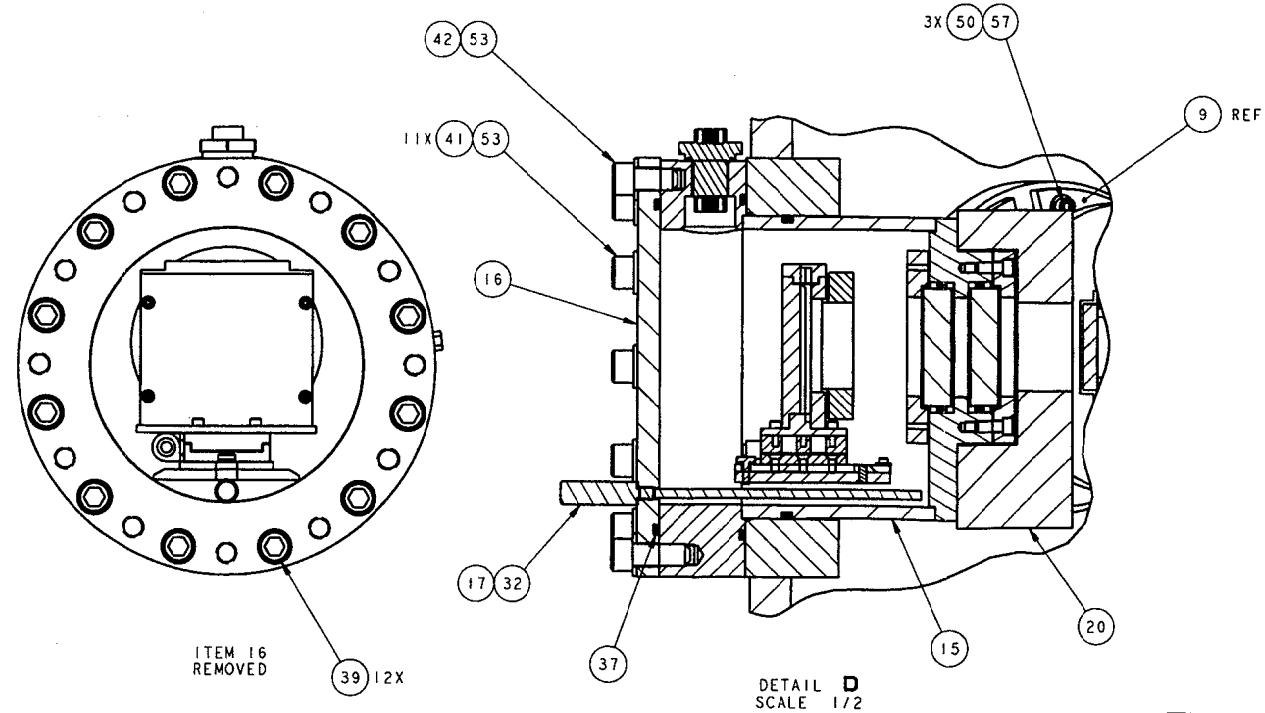
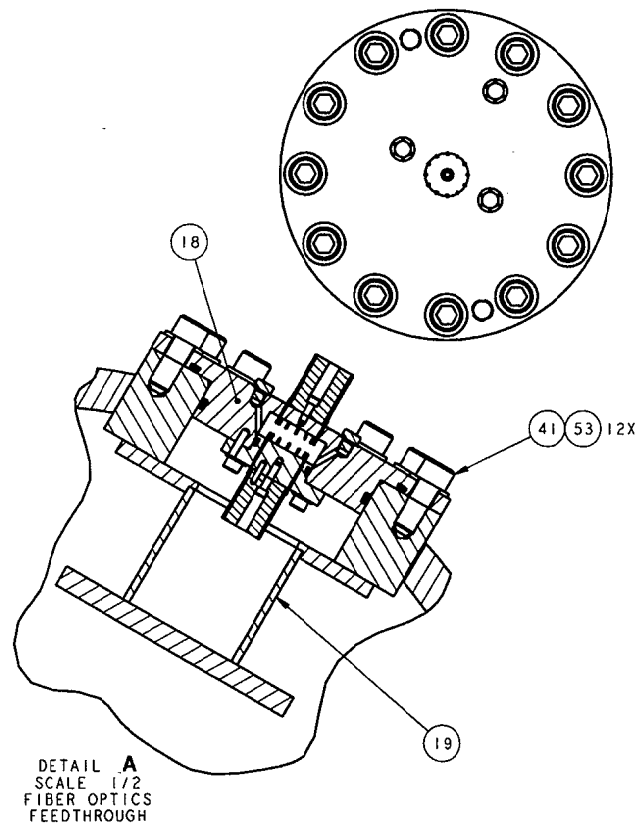
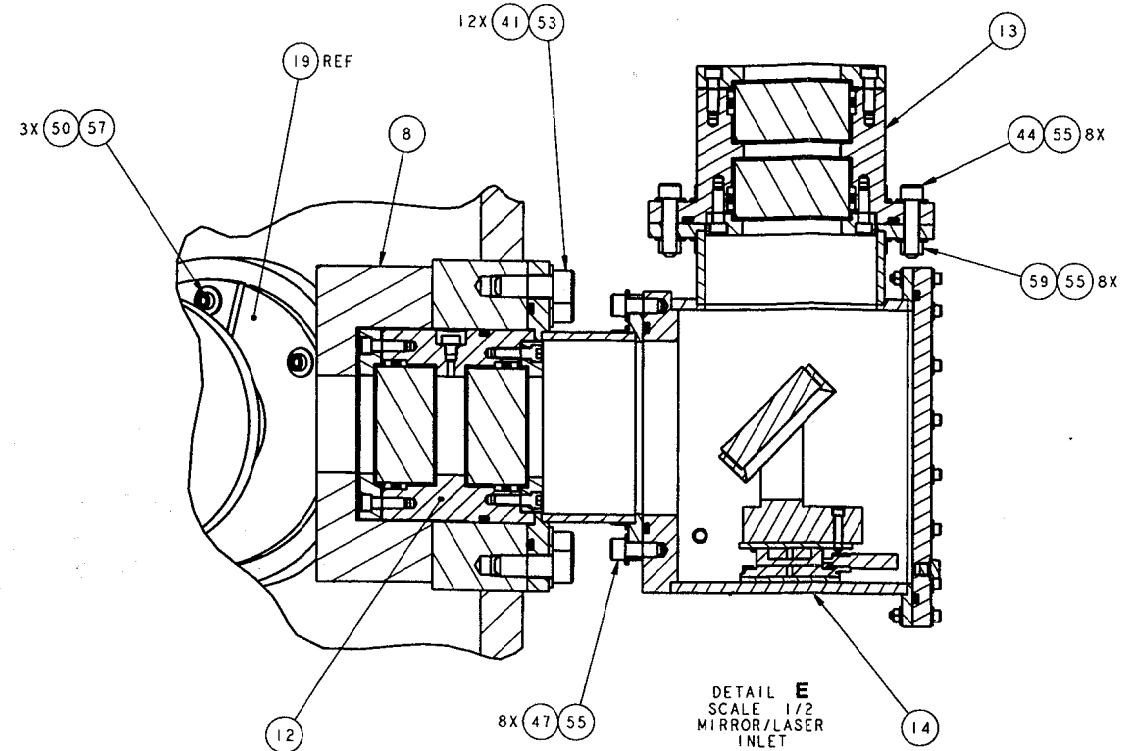
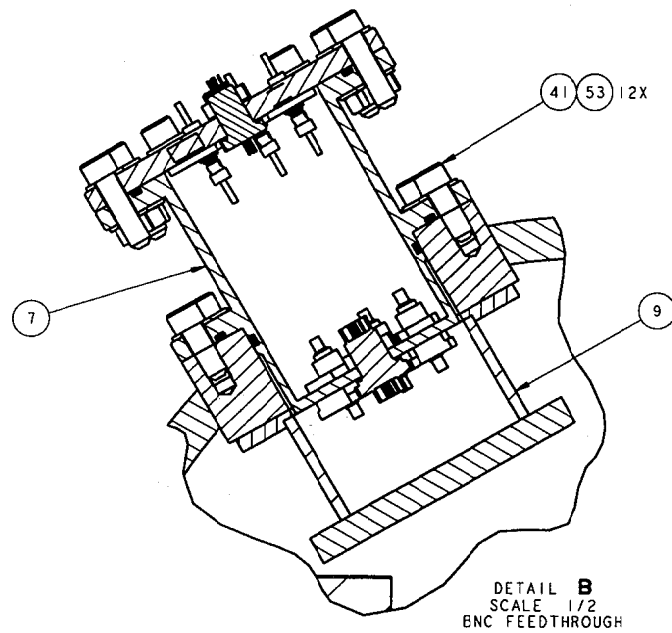
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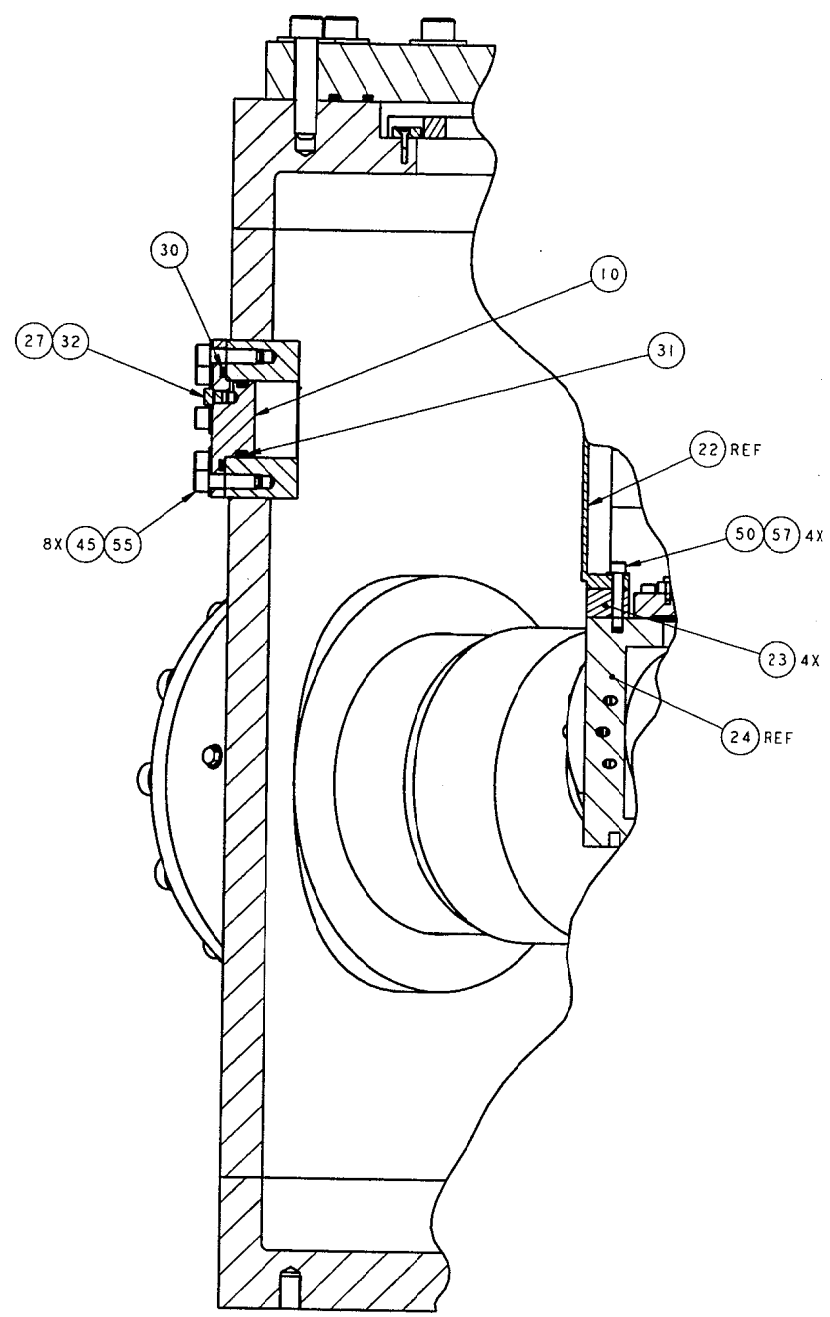
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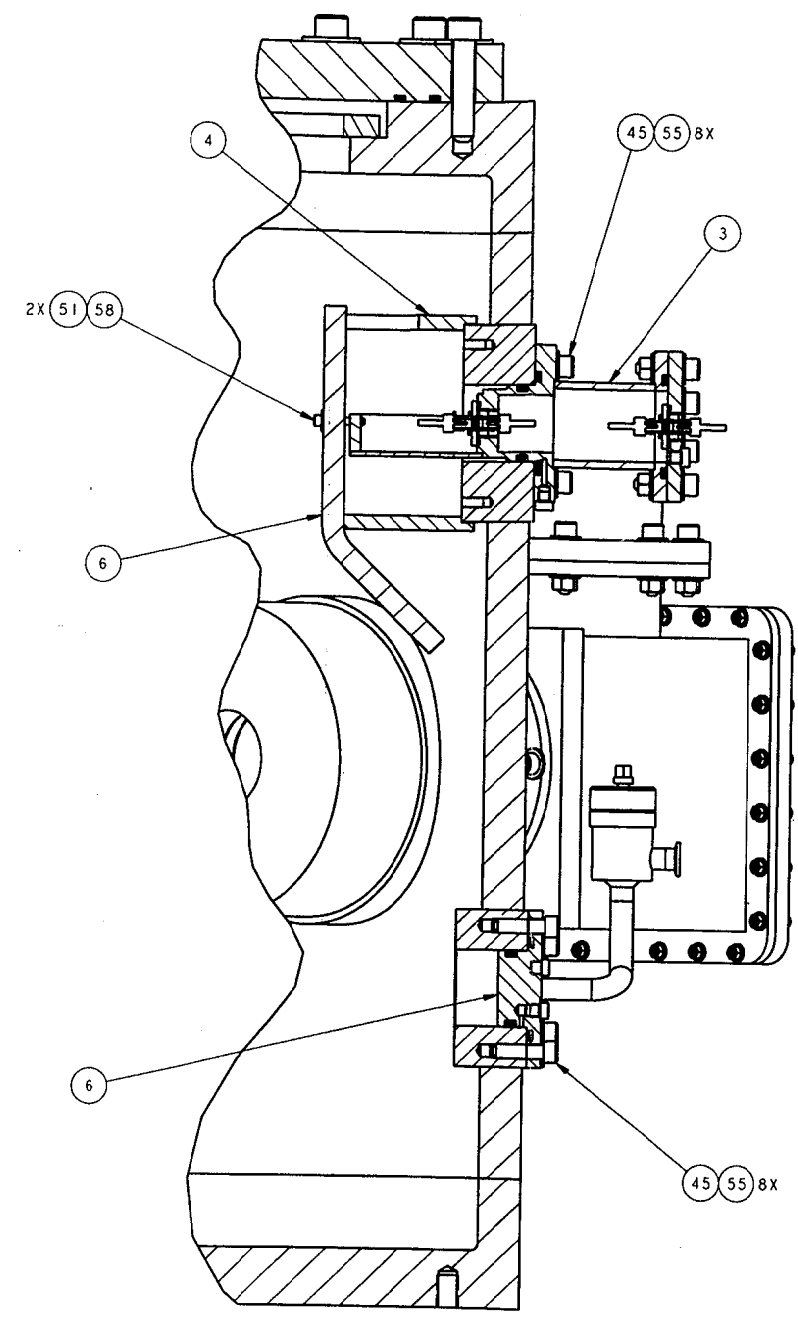
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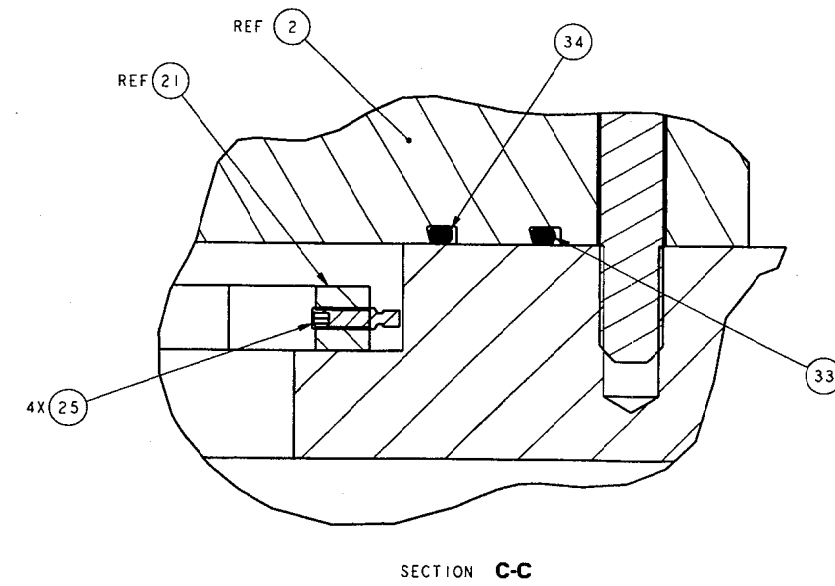
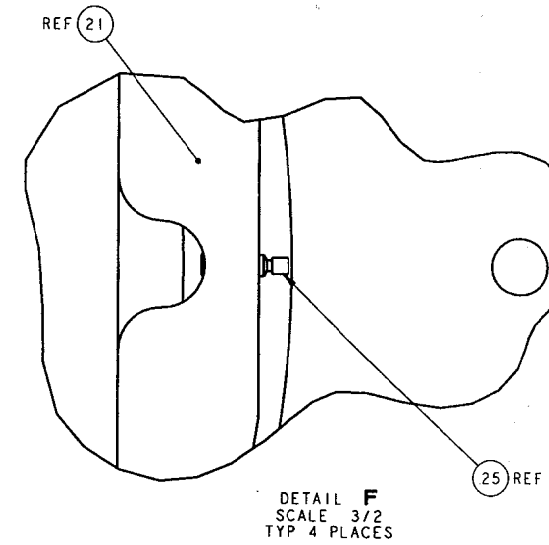
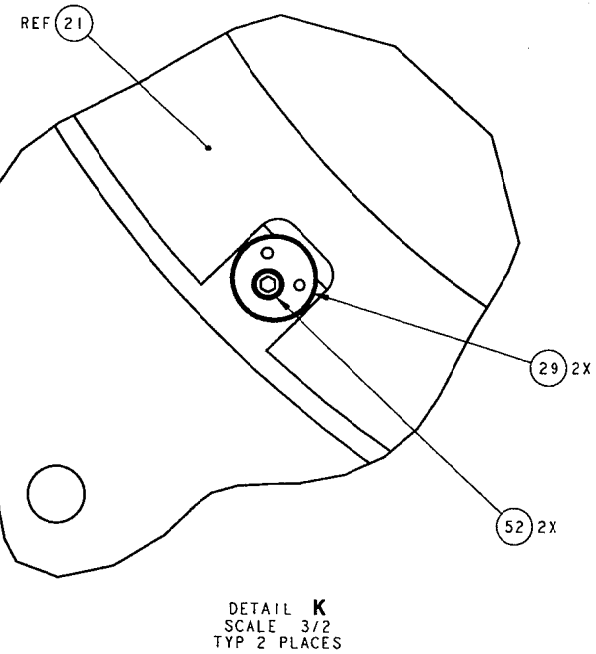
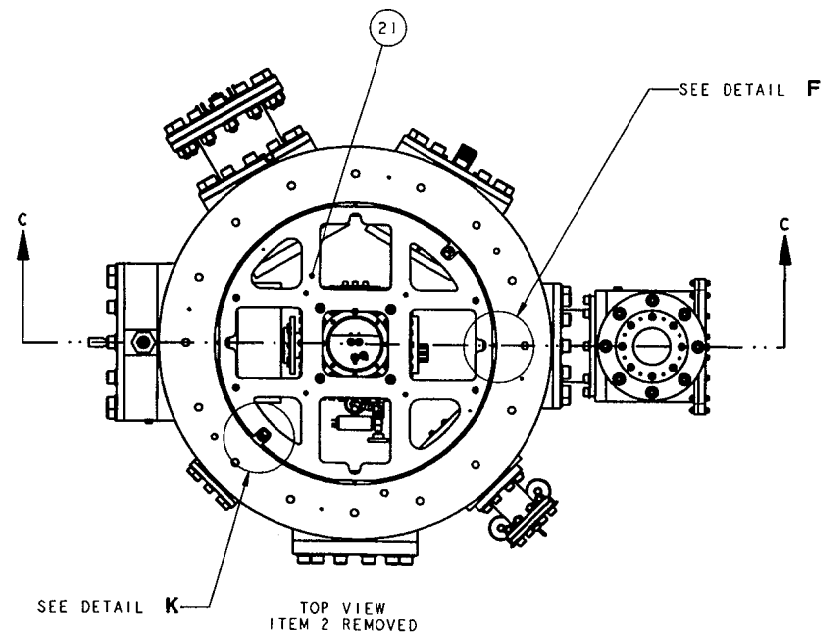


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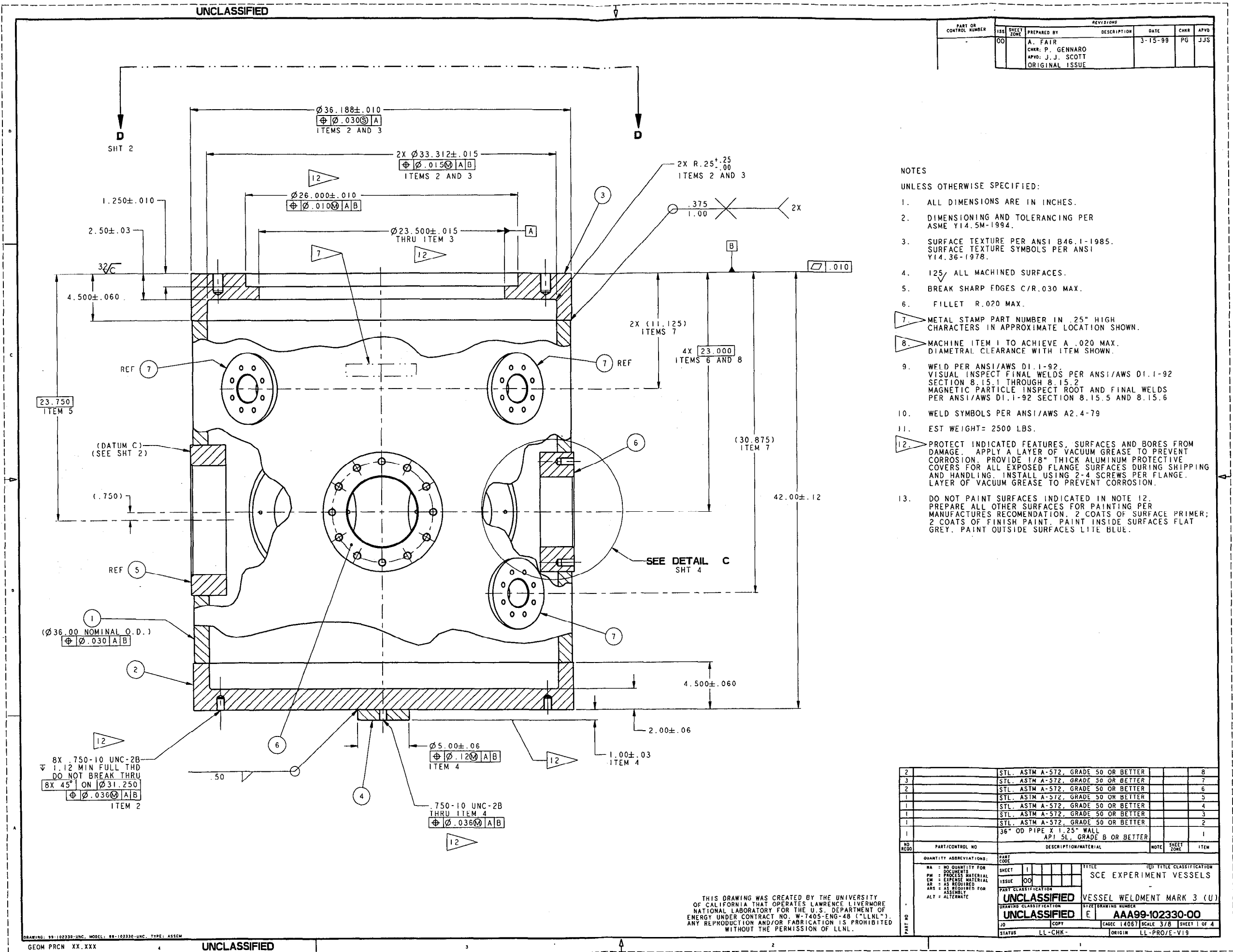
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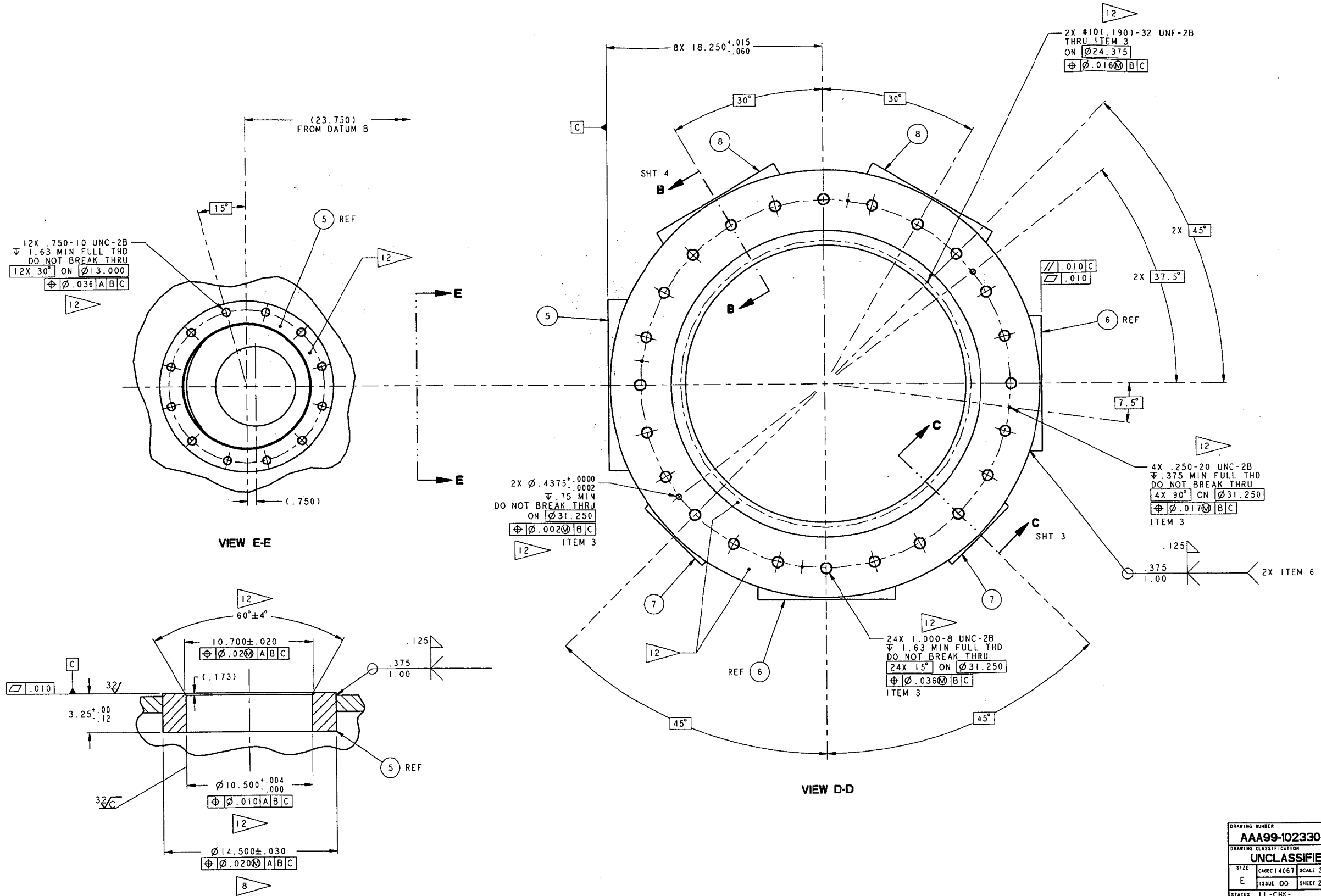
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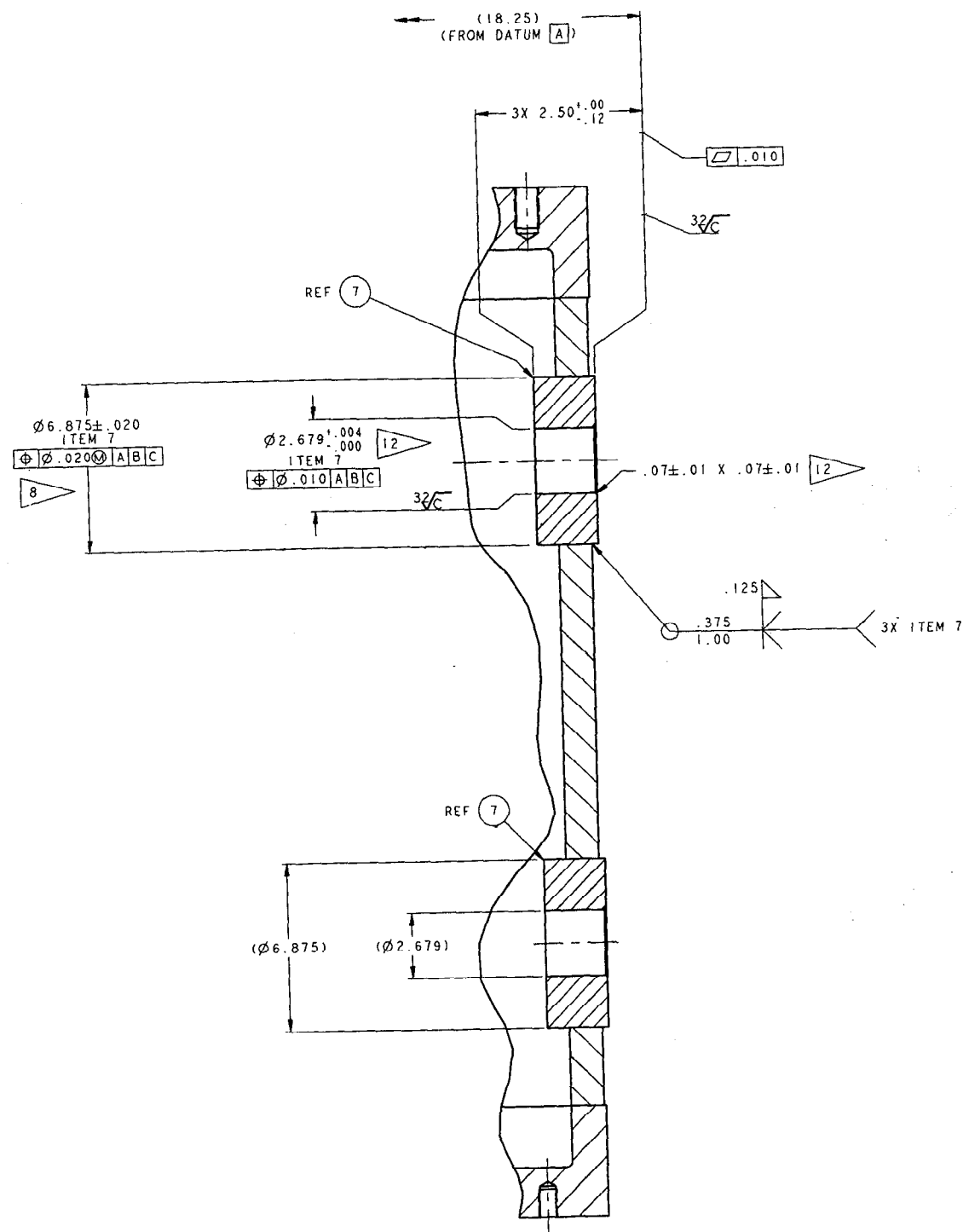


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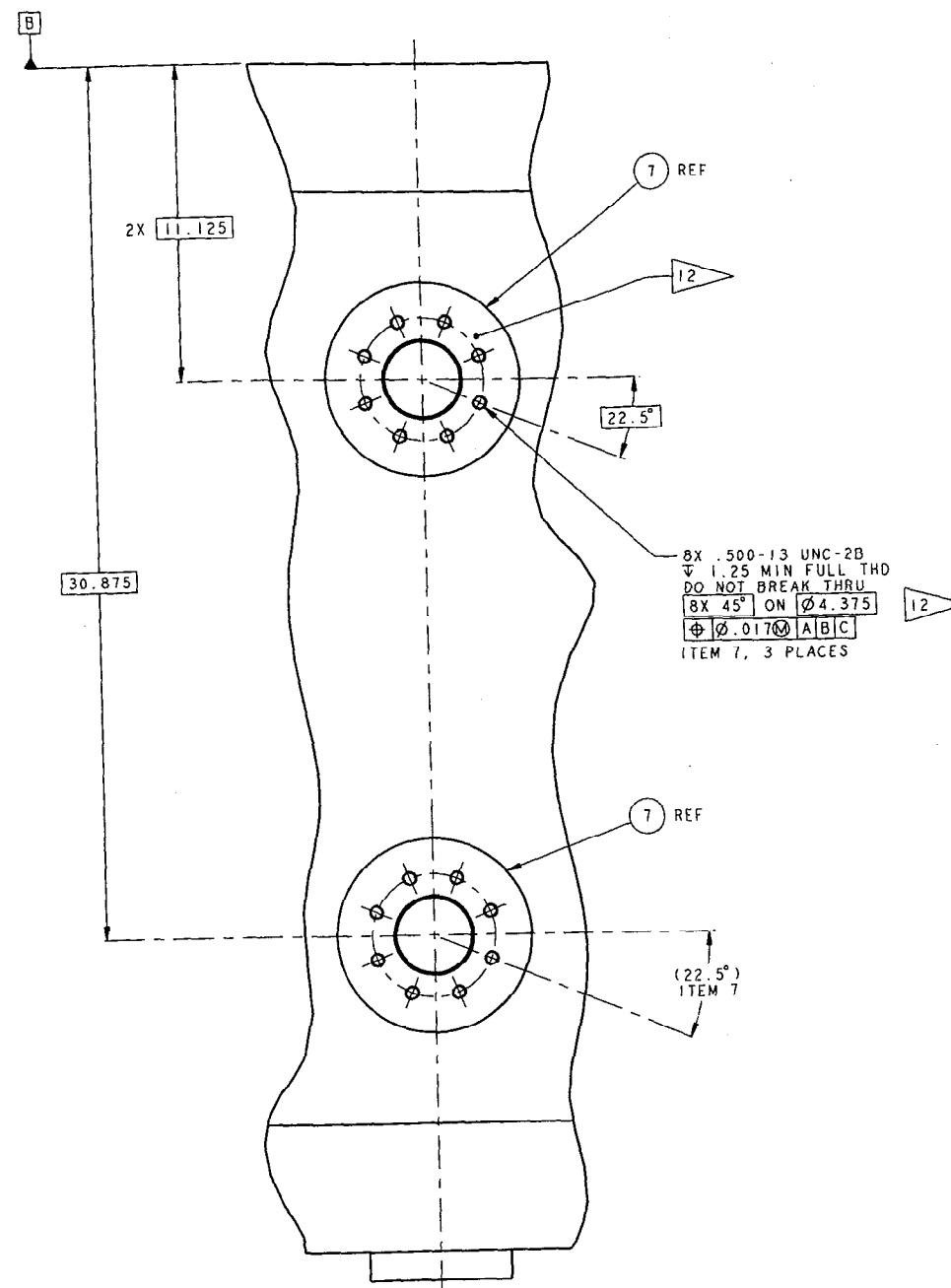


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STATUS	LL-CHK-	

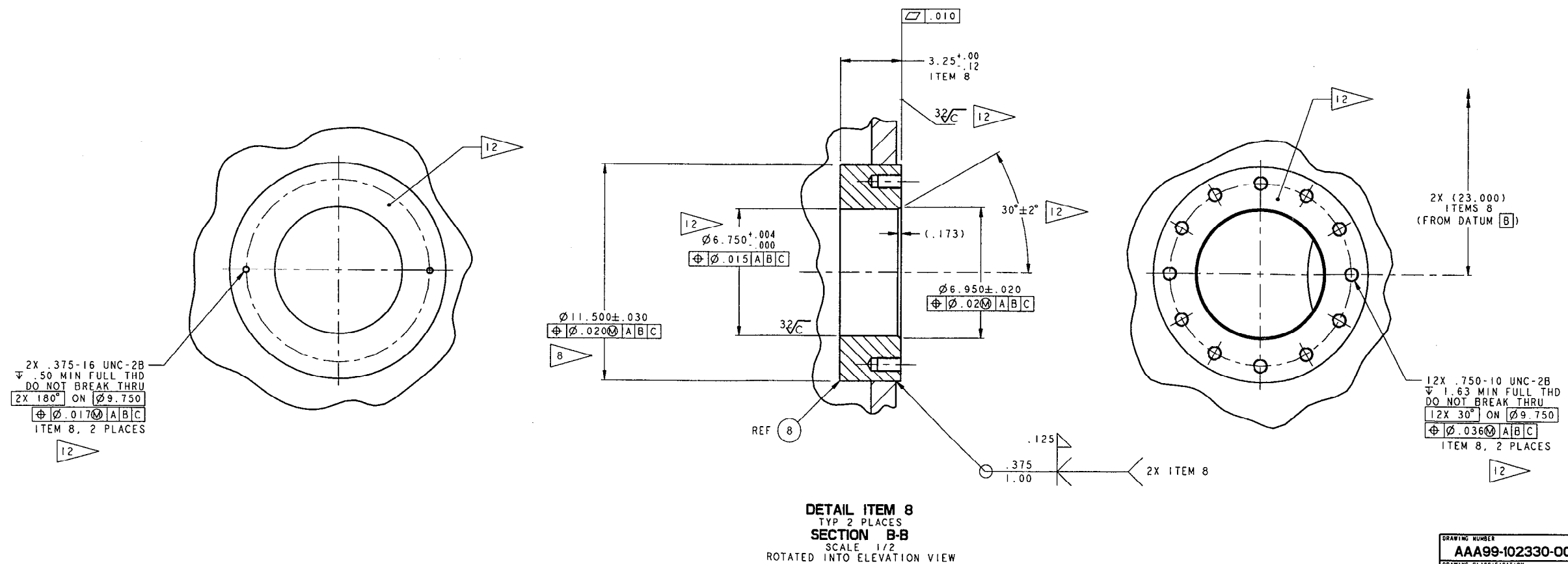
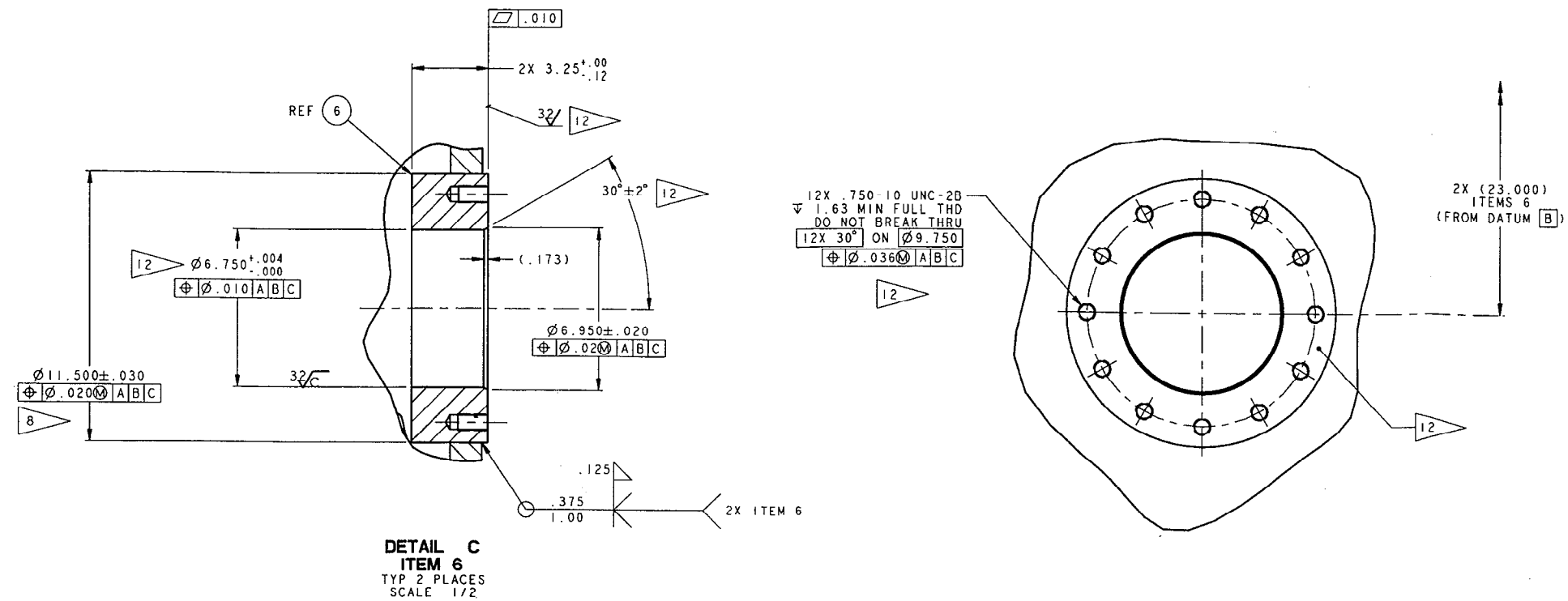


DETAIL ITEM 7
TYP 3 PLACES
SECTION C-C
SCALE 1/2
ROTATED INTO ELEVATION VIEW



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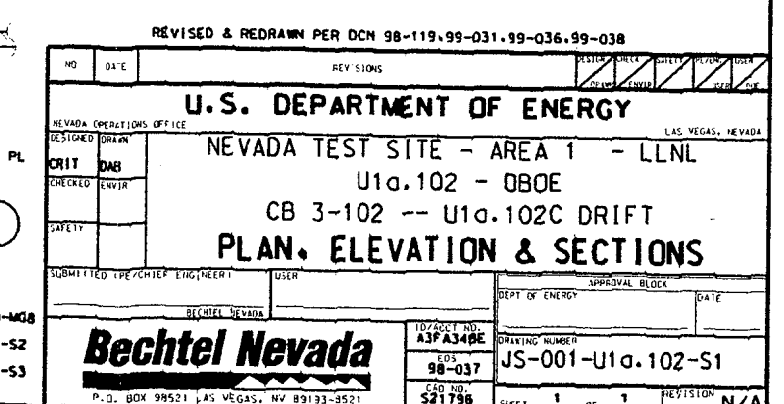
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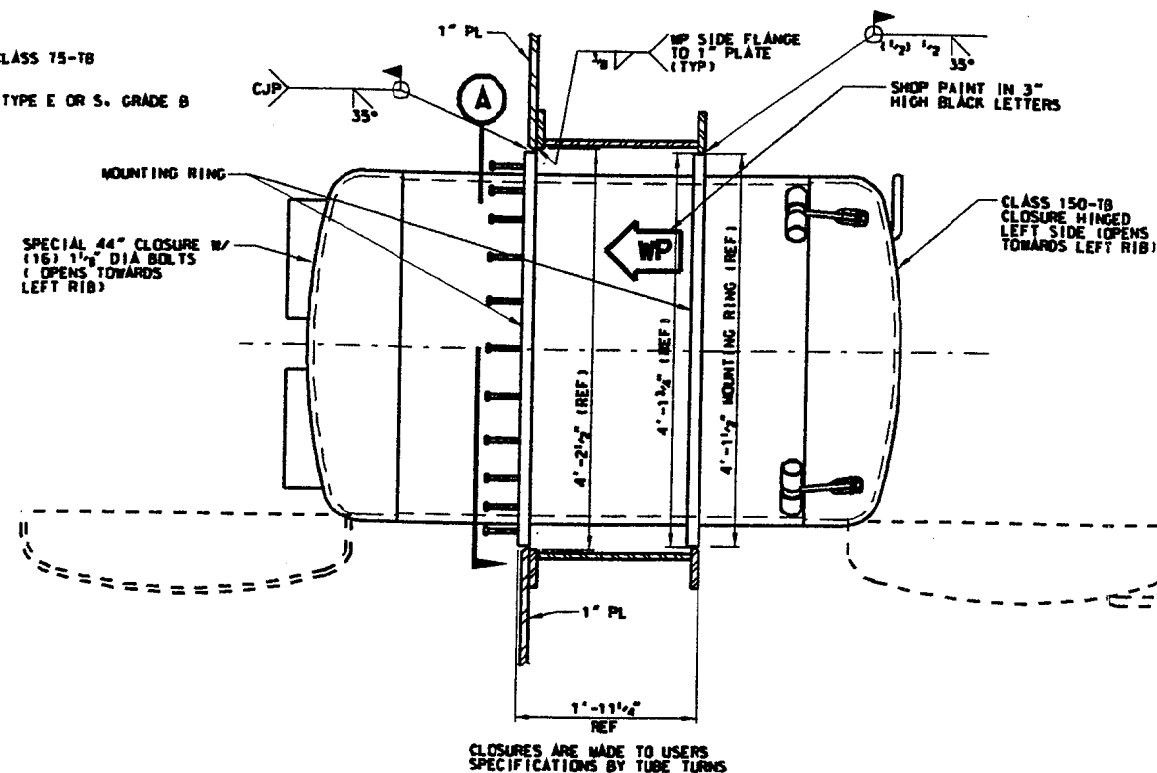
APPENDIX 3

Primary Containment Barrier Drawings

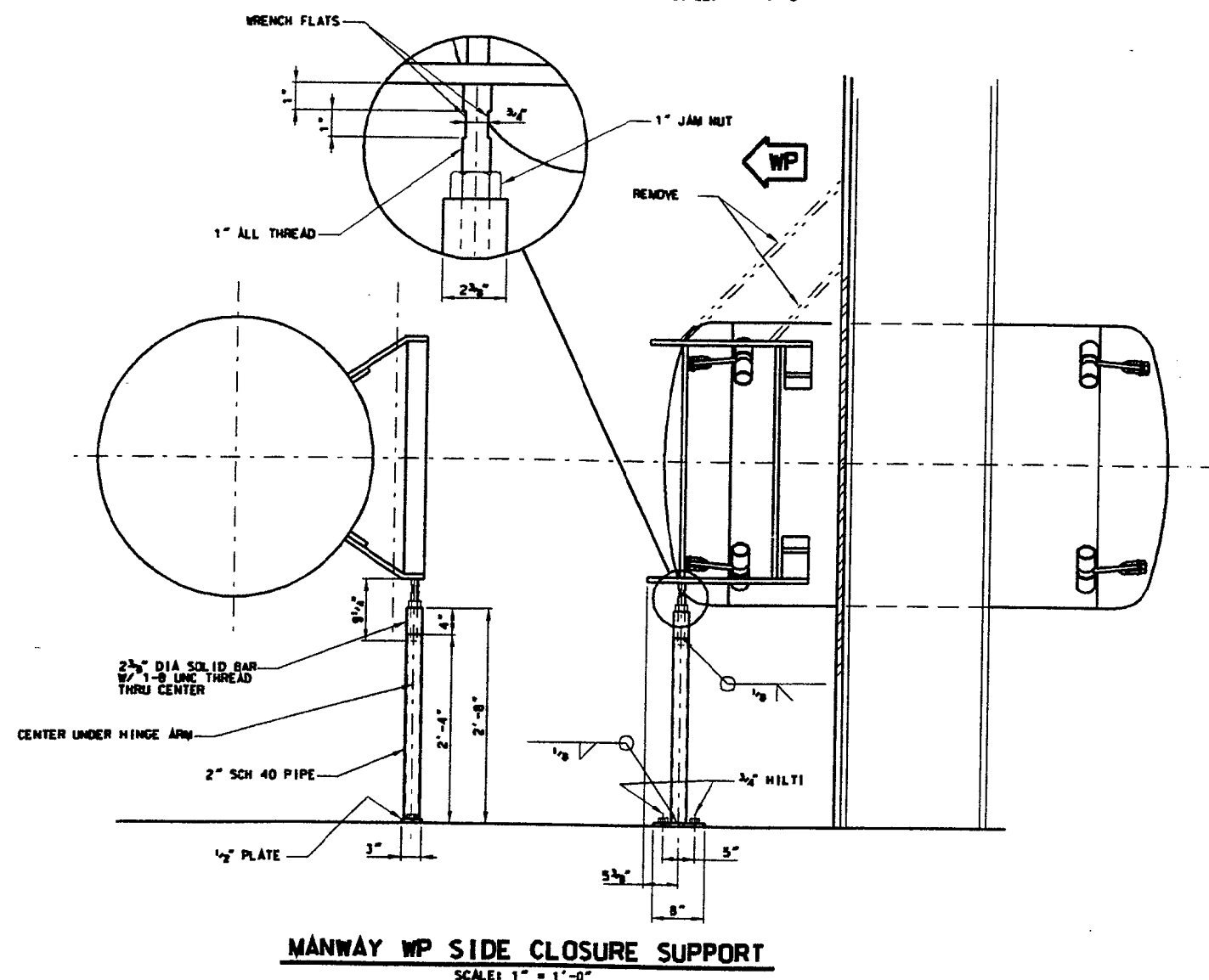


MANWAY NOTES:

1. HINGED CLOSURE SHALL BE TUBE TURNS OR E.O. CLASS 15-TB AS SPECIFIED
2. MANWAY PIPE SHALL BE ASTM A501 OR ASTM A53, TYPE E OR S, GRADE B OR ROLLED FROM ASTM A-36 PLATE..



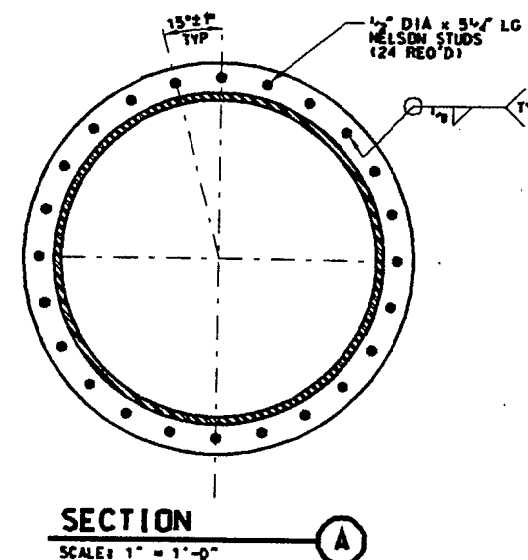
44" OD MANWAY - PLAN
SCALE: 1" = 1'-0"



MANWAY WP SIDE CLOSURE SUPPORT
SCALE: 1" = 1'-0"

GENERAL NOTES

- 1.0 MATERIAL
 - 1.1 ALL STEEL SHALL BE AS INDICATED BELOW UNLESS OTHERWISE NOTED:
 - a) ALL STEEL SHALL BE ASTM A-572, GRADE 50 (FY=50,000 PSI).
 - b) ALL PIPE SHALL BE ASTM A53, GRADE B (FY=35,000 PSI).
 - 1.2 ALL STEEL USED IN FABRICATION (PLATE, WELD FILLER METAL, ETC.) SHALL BE IN ACCORDANCE WITH THE APPLICABLE STANDARDS AND TRACEABLE TO THE MILL/MATERIAL TEST REPORT (MTR). COPIES OF THE MTR'S ARE TO BE SUBMITTED TO THE PROJECT ENGINEER PRIOR TO THE START OF FABRICATION.
- 2.0 WELDING REQUIREMENTS
 - 2.1 WELDING PROCEDURE QUALIFICATION - DOCUMENTATION OF THE WELDING PROCEDURE SPECIFICATION (WPS) AND PROCEDURE QUALIFICATION RECORD (PQR) ARE REQUIRED IN ACCORDANCE WITH THE AWS STRUCTURAL WELDING CODE D1.1, LATEST EDITION.
 - 2.2 WELDER QUALIFICATION - EACH WELDER/WELDING OPERATOR SHALL BE QUALIFIED AND SHALL HOLD A CURRENT WELDERS QUALIFICATION STATUS IN ACCORDANCE WITH THE AWS STRUCTURAL WELDING CODE D1.1, SECTION 4, LATEST EDITION.
 - 2.3 COPIES OF THE WPS AND PQR FOR EACH PROCESS AND THE WELDER(S)/WELDER OPERATOR(S) QUALIFICATION RECORDS ARE TO BE SUBMITTED TO THE PROJECT ENGINEER FOR REVIEW PRIOR TO START OF FABRICATION.
- 3.0 WELDING INSPECTION REQUIREMENTS
 - 3.1 VISUAL INSPECTION (VT)
 - 3.1.1 ALL ROOT AND FINAL WELDS SHALL BE VISUALLY INSPECTED (VT) BY THE INSPECTOR PRIOR TO THE APPLICATION OF MAGNETIC PARTICLE (MT) EXAMINATION.
 - 3.1.2 ANY ONE OR A COMBINATION OF THE FOLLOWING DISCOVERED DURING THE VISUAL INSPECTION SHALL REQUIRE REPAIR:
 - a) ALL CRACKS
 - b) ALL HOLES/CRATERS
 - c) UNDERCUTTING GREATER THAN 2" IN ANY 12" LENGTH, AND DEPTHS EXCEEDING 1/8".
 - 3.2 MAGNETIC PARTICLE EXAMINATION (MT)
 - 3.2.1 ALL ROOT AND FINAL WELDS SHALL BE 100% MAGNETIC PARTICLE INSPECTED IN ACCORDANCE WITH NOT SECTION PROCEDURE L-F30.20SP.
 - 3.2.2 PERSONNEL PERFORMING MAGNETIC PARTICLE INSPECTION SHALL BE QUALIFIED IN ACCORDANCE WITH NOT SECTION PROCEDURE L-F30.20SP, AS APPLICABLE FOR THE TECHNIQUE AND METHOD USED.
 - 3.2.3 ALL MT EXAMINATION SHALL BE COMPLETED USING CONTINUOUS CONTRASTING COLOR DRY POWDER, AC, YOKO METHOD.
 - 3.2.4 EVALUATION OF THE MT EXAMINATION SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE STRUCTURAL WELDING CODE, AWS D1.1, SECTION 6.10, LATEST EDITION.
 - 3.3 ALL WELD AREAS THAT DO NOT SATISFY AWS D1.1 SECTION 6.10 SHALL BE GRIND OUT, REWELDED (IF REQUIRED) AND RE-INSPECTED.
- 4.0 INSPECTION
 - 4.1 TITLE III INSPECTION IS REQUIRED.
 - 4.2 FINAL ACCEPTANCE SHALL BE BASED ON THE FOLLOWING:
 - a) VISUAL INSPECTION AND ACCEPTANCE OF ALL WELDS
 - b) REVIEW AND ACCEPTANCE OF THE MT TEST REPORTS
 - c) VERIFICATION THAT THE COMPLETED ASSEMBLY MEETS THE REQUIREMENTS OF THE DESIGN DRAWING.
- 5.0 DIMENSIONAL TOLERANCES ARE +/- .0 UNLESS OTHERWISE NOTED. DIMENSIONAL TOLERANCES FOR WELDS ARE +/- .0 UNLESS OTHERWISE NOTED.
- 6.0 DO NOT SCALE DRAWING FOR CONSTRUCTION PURPOSES.

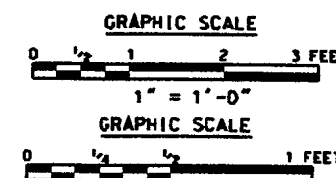


SECTION A
SCALE: 1" = 1'-0"

REFERENCE DRAWINGS

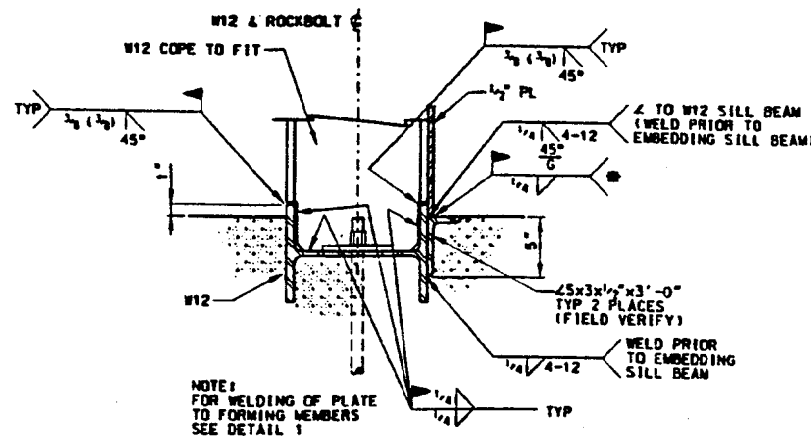
CB 3-102 - PLAN, ELEV -----JS-001-U10.102-S1

REVISED & REDRAWN PER DCN 99-043, ROI 98-246	
NO	DATE
REVISIONS	
U.S. DEPARTMENT OF ENERGY	
NEVADA TEST SITE - AREA 1 - LLNL	
U10.102 - OBOE	
CB 3-102 -- U10.102C DRIFT	
GENERAL NOTES & 44" DIA MANWAY	
DESIGNED BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE
Bechtel Nevada	
PROJECT NO.	DATE
98-037	JS-001-U10.102-S3

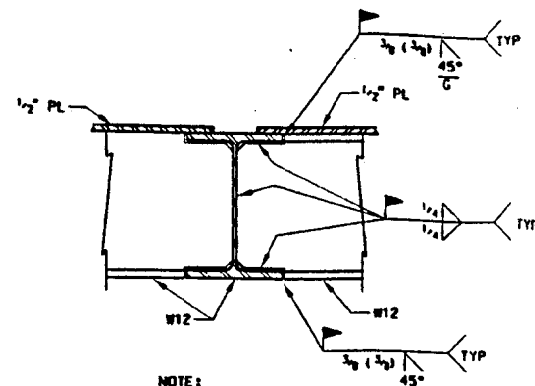


APPENDIX 4

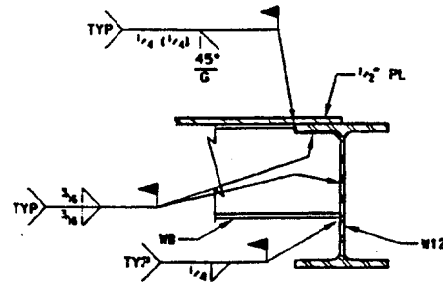
Secondary Containment Barrier Drawings



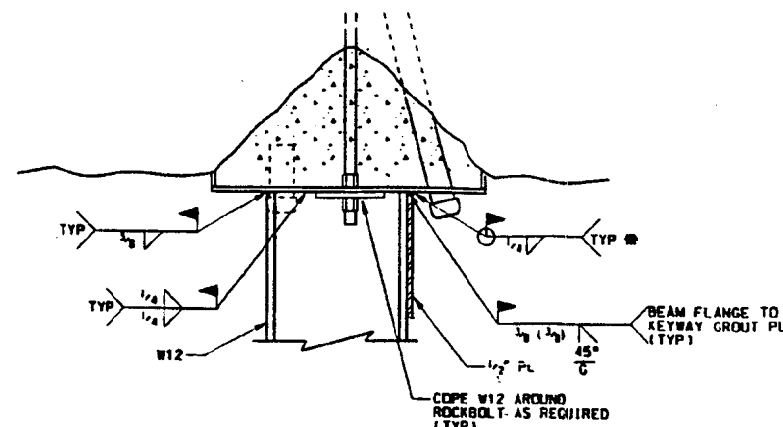
SECTION A
SCALE: 1 1/2" = 1'-0" S1



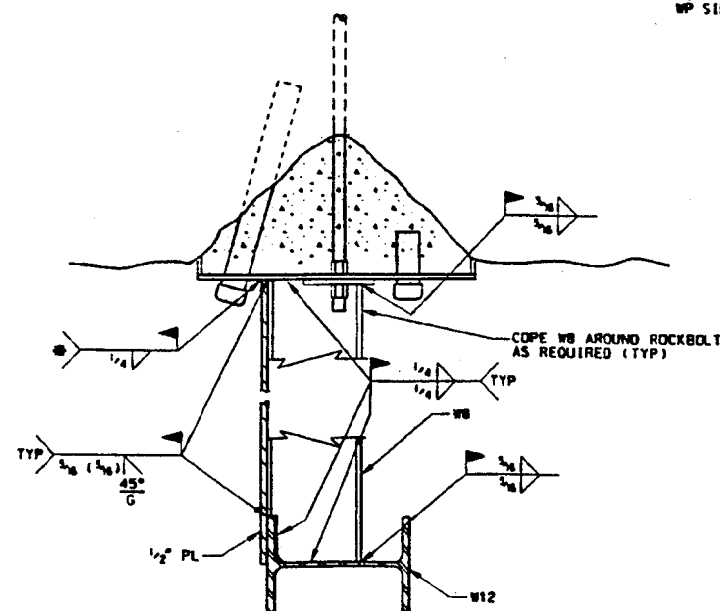
SECTION C
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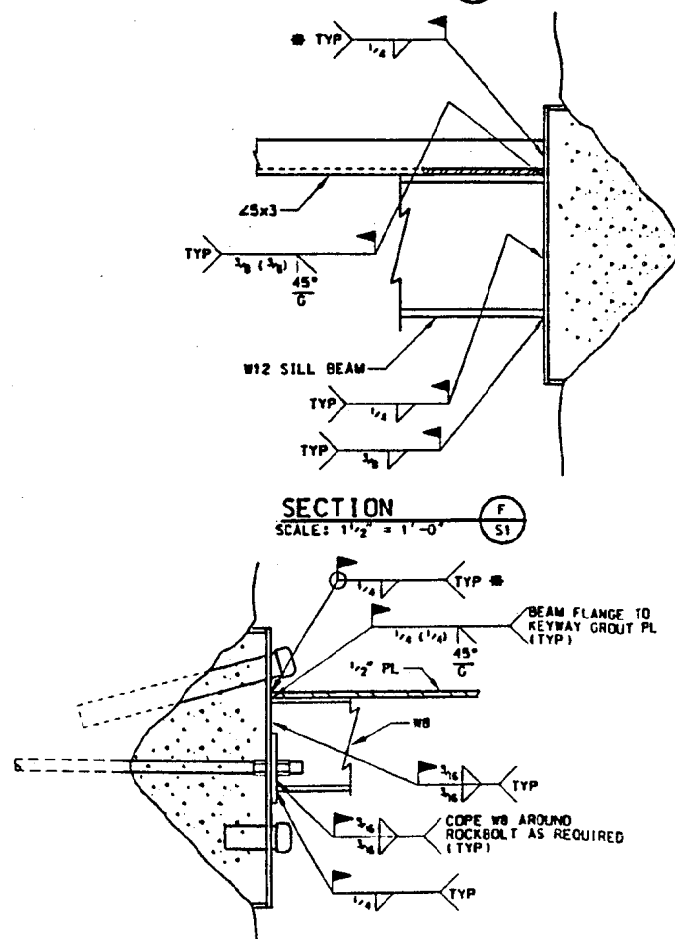
SECTION B
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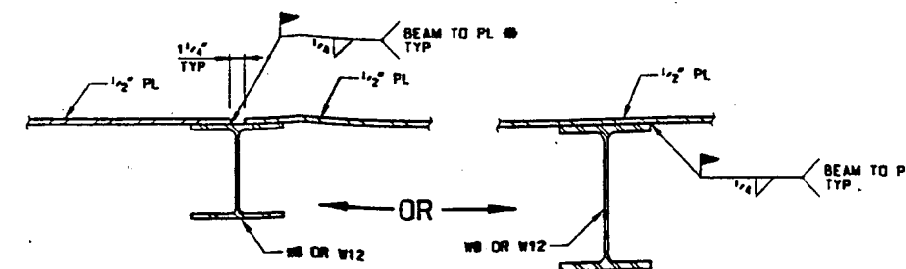
SECTION E
SCALE: 1 1/2" = 1'-0" S1



SECTION D
SCALE: 1 1/2" = 1'-0" S1



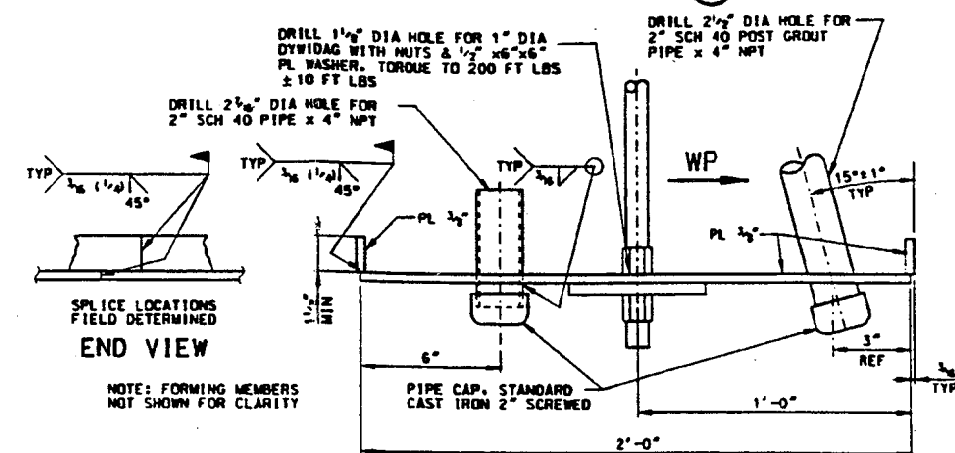
SECTION F
SCALE: 1 1/2" = 1'-0" S1



NOTE: FORMING MEMBERS NOT SHOWN FOR CLARITY

DETAIL - PLATE TO BEAM WELDING 1

SCALE: 1 1/2" = 1'-0"



NOTE: FORMING MEMBERS NOT SHOWN FOR CLARITY

DETAIL - KEYWAY GROUT PLATE 1 ROTATED 90°

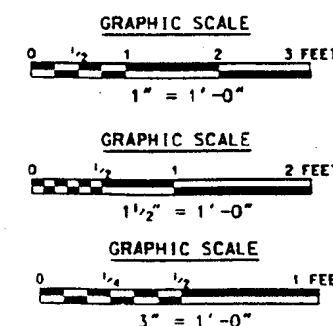
SCALE: 1" = 1'-0"

NOTE: APPLY LIQUID STEEL TO ROCKBOLT NUTS AND PIPE CAPS TO POST GROUT LINES.

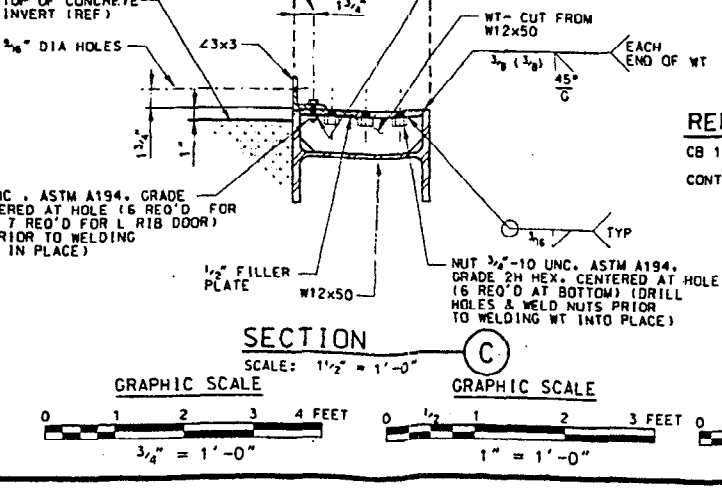
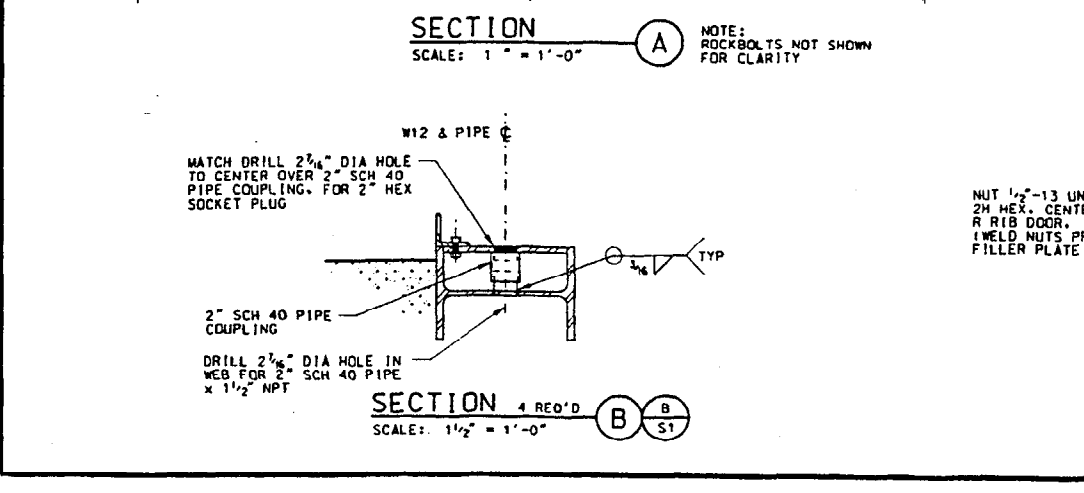
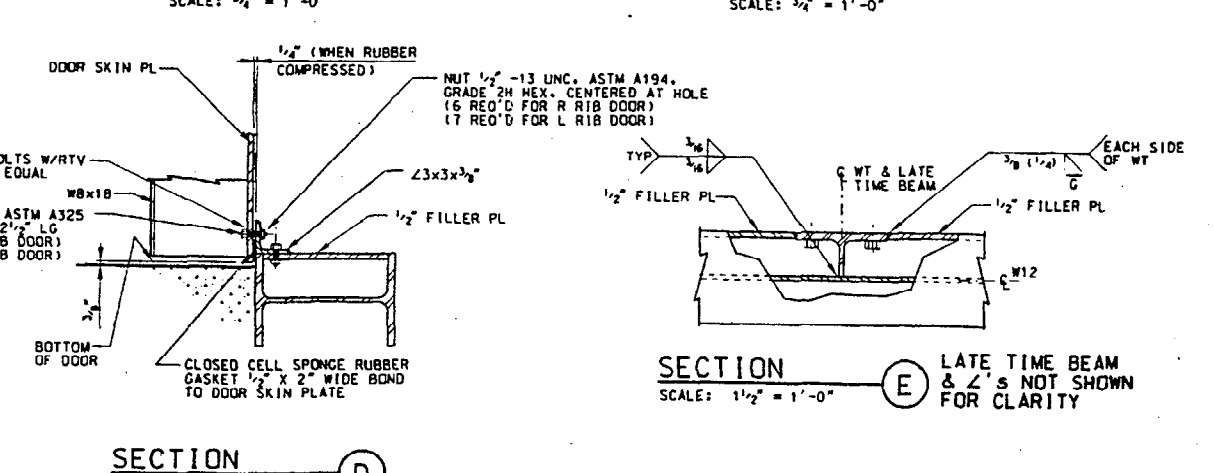
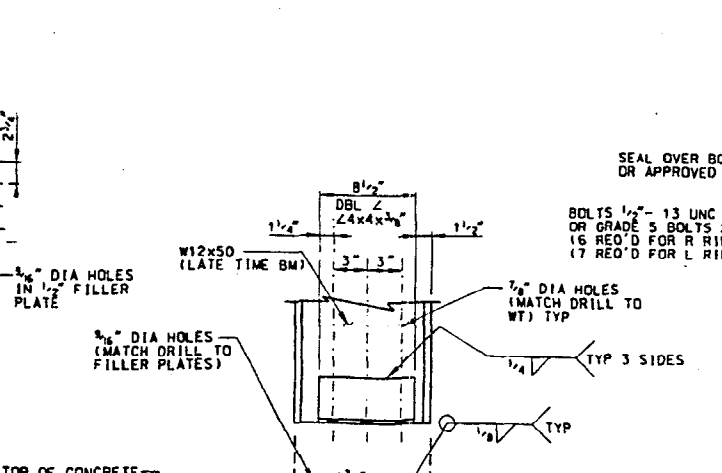
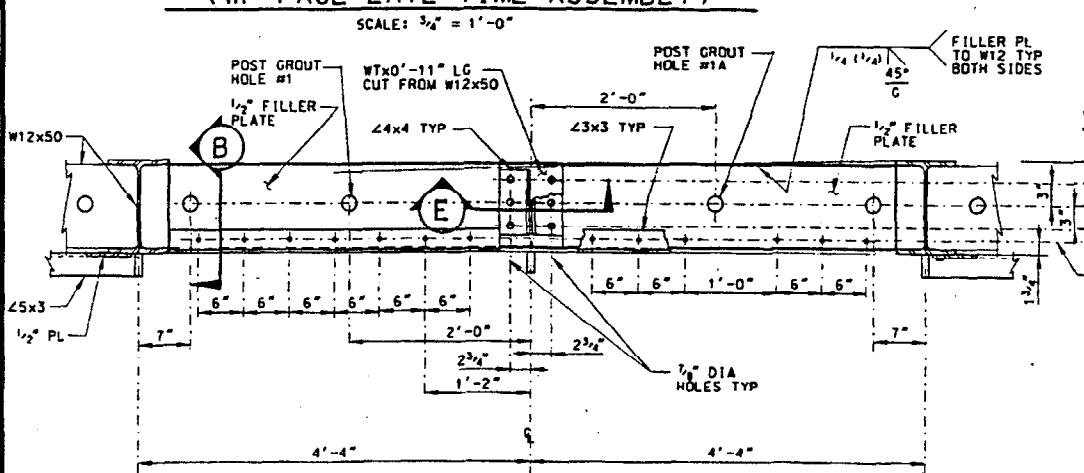
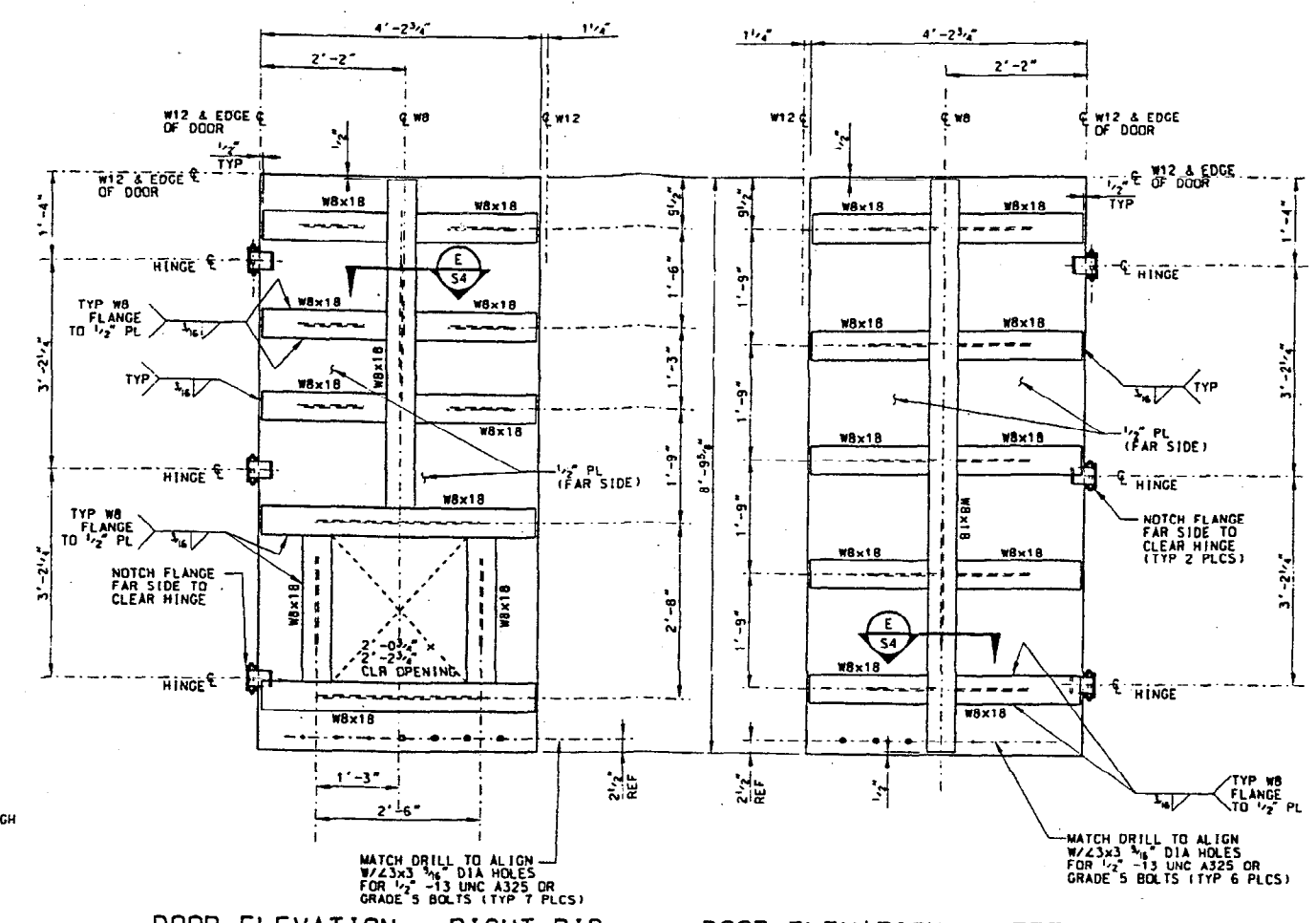
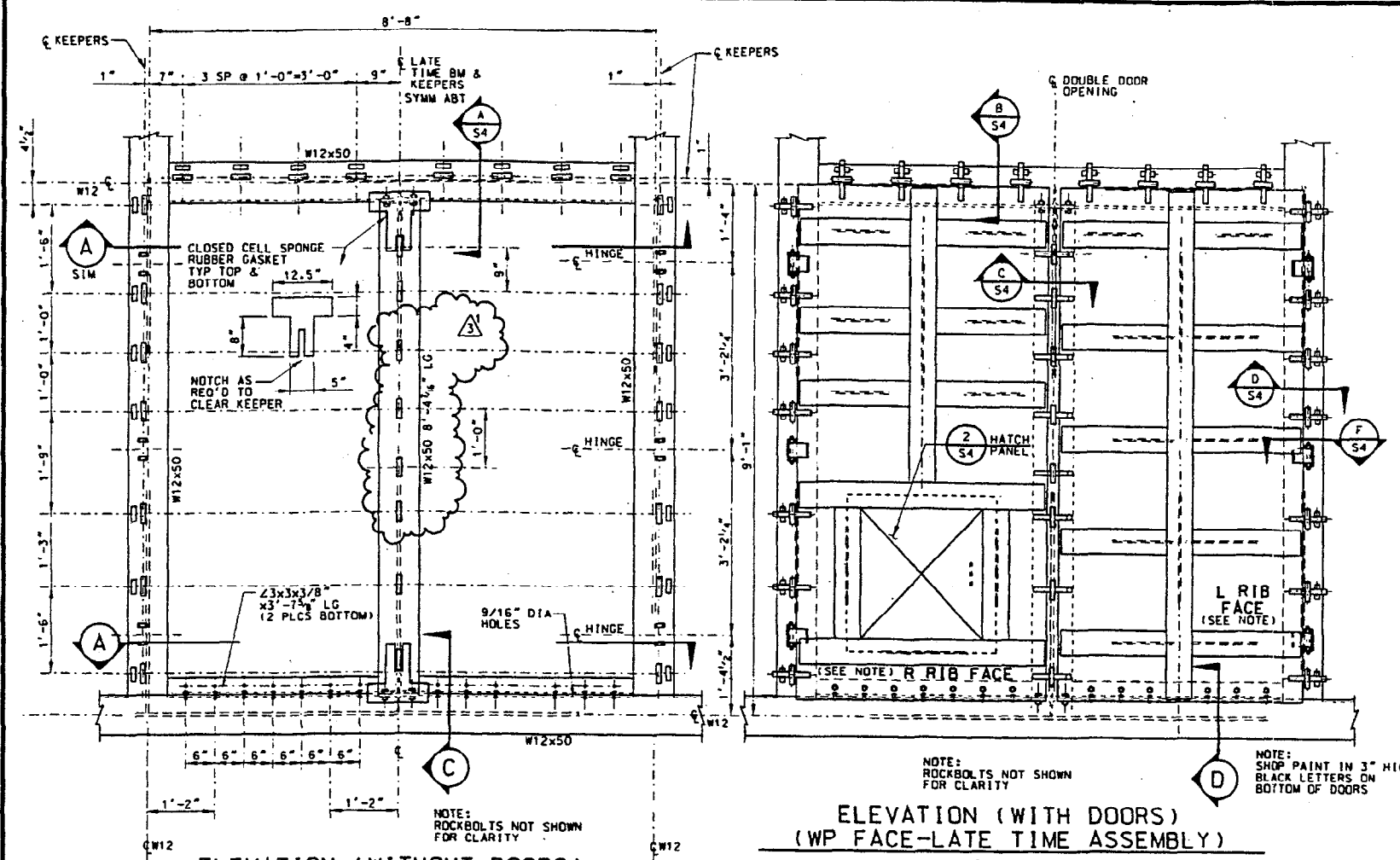
AS-BUILT	FROM REV. 0
BECHTEL NEVADA	
DRAWN BY: J. B. Bland	CHECKED BY: J. B. Bland
DATE: 6/17/97	DATE: 6/18/97

REFERENCE DRAWINGS

CB 1-100 - PLAN, ELEV & GEN NOTES JS-001-U1a.100-S1



REVISED TO REFLECT AS-BUILT CONDITIONS PER EDS 96-145		CRIT. DATE	
U.S. DEPARTMENT OF ENERGY		LAS VEGAS, NEVADA	
NEVADA TEST SITE - AREA 1 - LLNL			
U1a.100			
CB 1-100 -- U1a.100 DRIFT			
DETAILS & SECTIONS			
DESIGNED BY: J. B. Bland	CHECKED BY: J. B. Bland	DATE: 6/17/97	DATE: 6/18/97
SUBMITTED TO: CHIEF ENGINEER		APPROVAL: J. B. Bland	
HELEN J. HALL 5/23/96		5 THOMAS 5/28/96	
Bechtel Nevada		JS-001-U1a.100-S2.1	
P.O. BOX 99321 LAS VEGAS, NV 89193-0321		SHEET 1 OF 1	



REFERENCE DRAWINGS
CB 1-100 - PLAN, ELEVATION & GEN NOTES - JS-001-U10.100-S1
CONTAINMENT DOOR - SECTIONS & DETS - JS-001-U10.100-S4

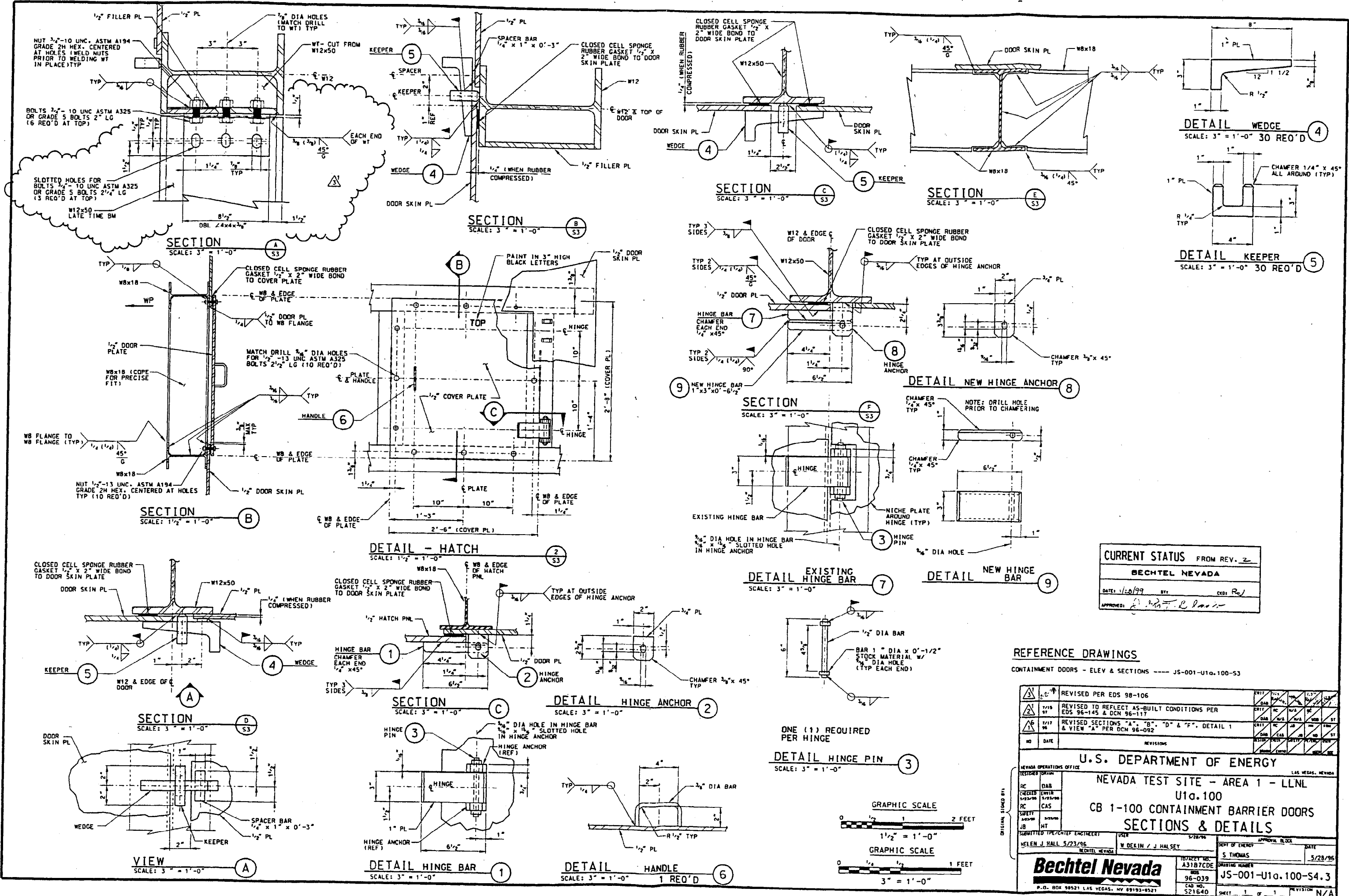
CURRENT STATUS FROM REV. 2
BECHTEL NEVADA
DATE: 1/28/99 BY: CDD/RW

NO.	DATE	REVISIONS
1	1/15/97	REVISED PER EDS 98-106
2	1/15/97	REVISED TO REFLECT AS-BUILT CONDITIONS PER EDS 96-145, DCN'S 96-139, 96-237 & 97-040
3	1/17/96	REVISED SECTION "A" PER DCN 96-091

U.S. DEPARTMENT OF ENERGY
NEVADA TEST SITE - AREA 1 - LLNL
U10.100
CB 1-100 CONTAINMENT BARRIER DOORS
ELEVATIONS & SECTIONS

Bechtel Nevada
P.O. BOX 90521 LAS VEGAS, NV 89193-0521

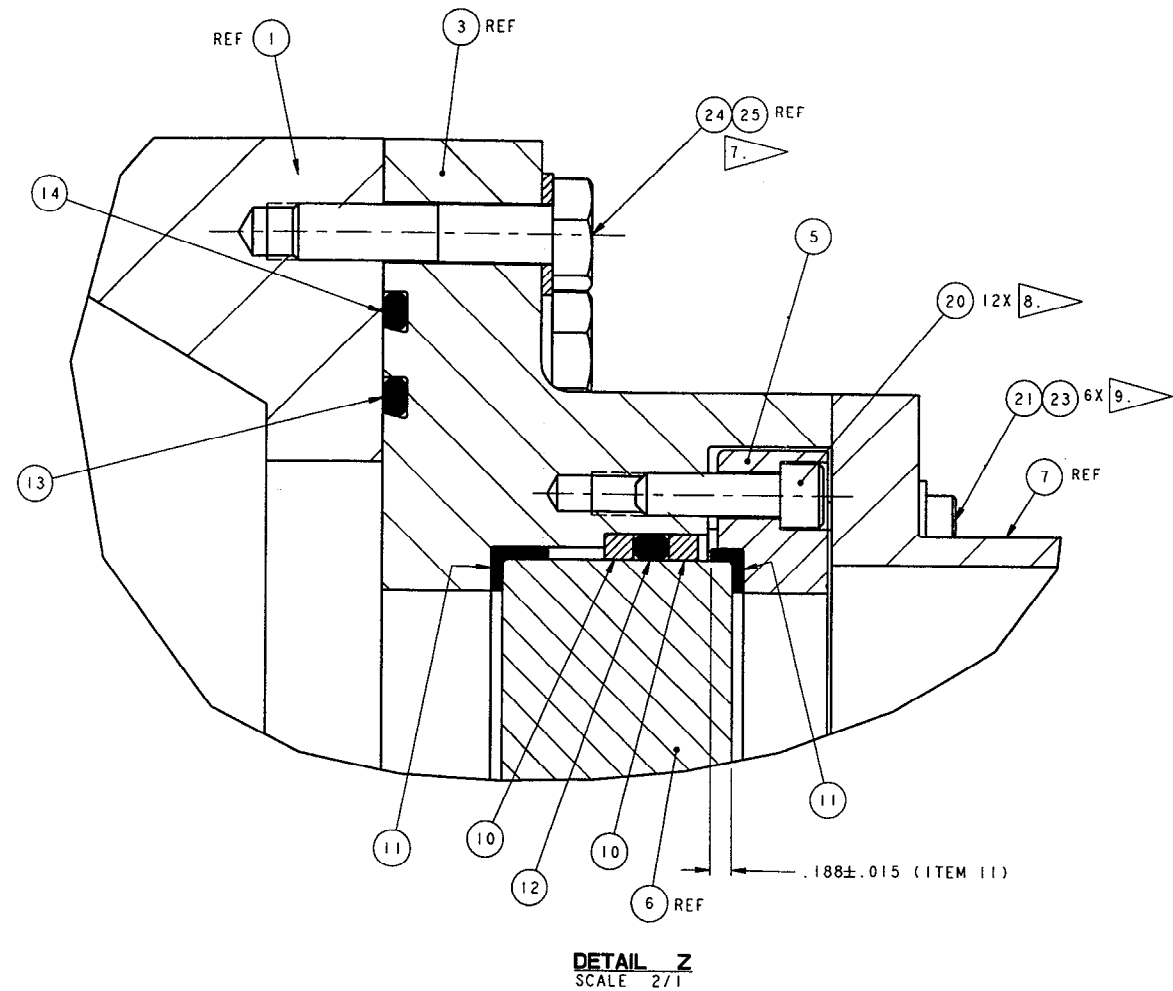
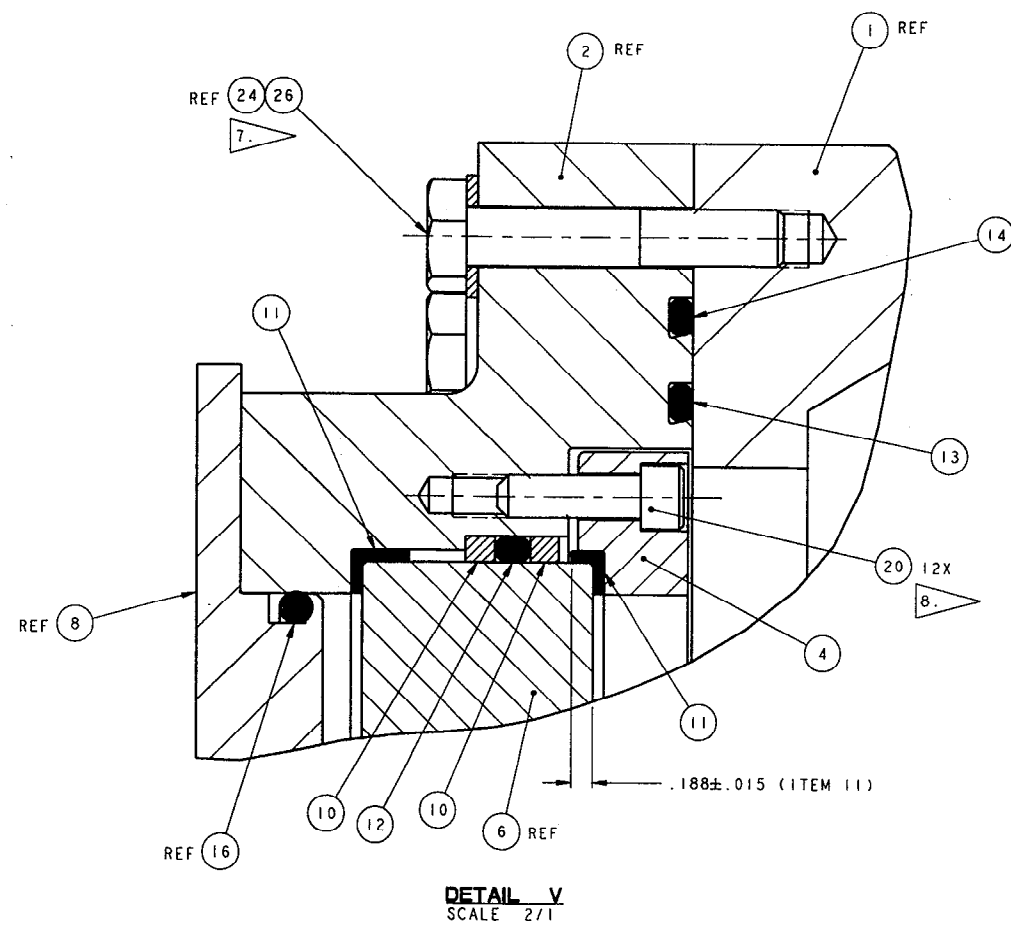
REVISIONS
SHEET 1 OF 1
REVISION N/A



APPENDIX 5

Optical Ports Drawings

Plot Date: Mon Mar 29 11:14:56 PST 1999. Plotted By: cpg.



DRAWING NUMBER			
AAA98-116028-00			
DRAWING CLASSIFICATION			
UNCLASSIFIED			
SIZE	CAGEC 14067	SCALE	1/2
E	ISSUE 00	SHEET	2 OF 2
STATUS LL-CHK-			

UNCLASSIFIED

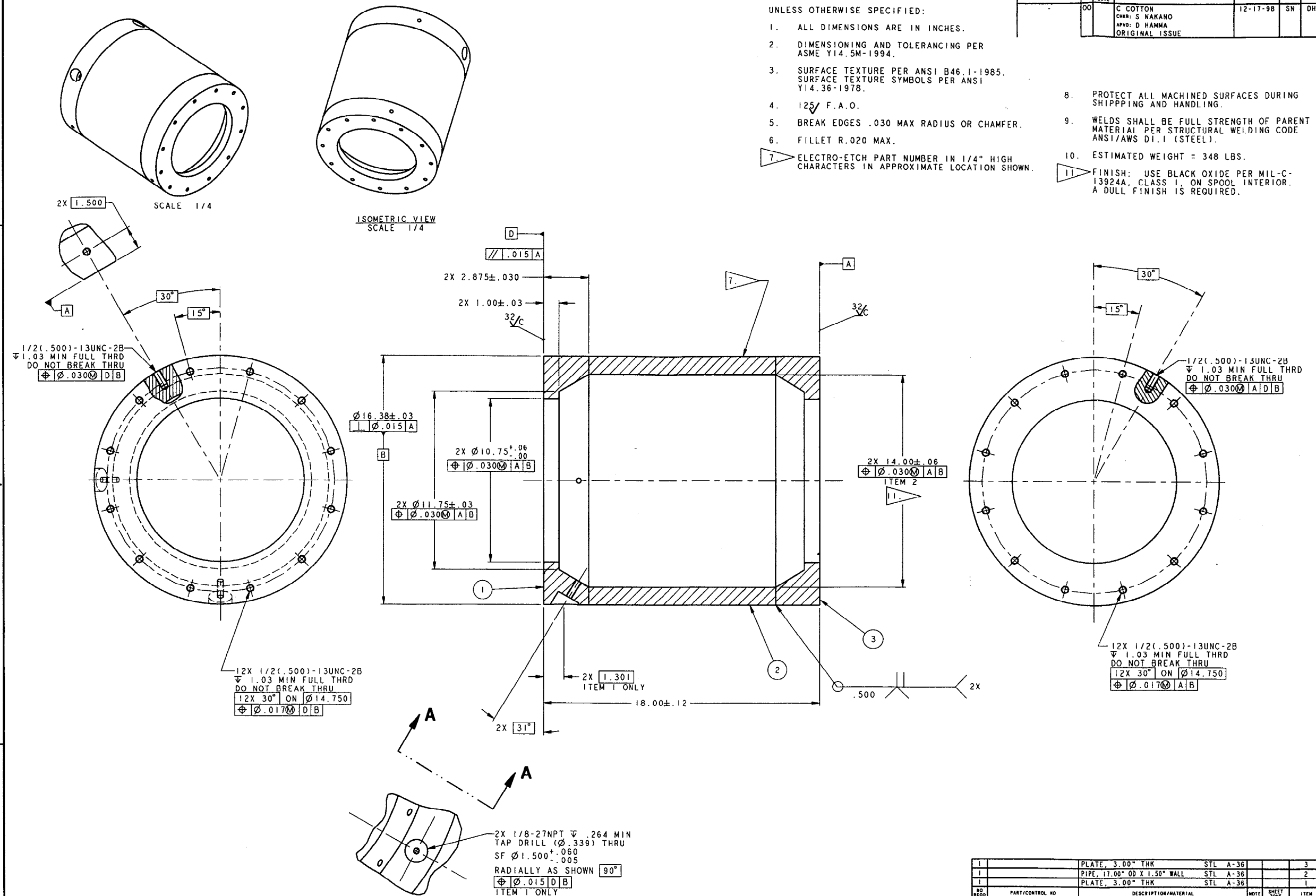
NOTES

UNLESS OTHERWISE SPECIFIED:

1. ALL DIMENSIONS ARE IN INCHES.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
3. SURFACE TEXTURE PER ANSI B46.1-1985. SURFACE TEXTURE SYMBOLS PER ANSI Y14.36-1978.
4. 125/ F.A.O.
5. BREAK EDGES .030 MAX RADIUS OR CHAMFER.
6. FILLET R.020 MAX.
7. ELECTRO-ETCH PART NUMBER IN 1/4" HIGH CHARACTERS IN APPROXIMATE LOCATION SHOWN.

PART OR CONTROL NUMBER		REVISIONS			
ISS	SHEET ZONE	PREPARED BY	DESCRIPTION	DATE	CHN
00		C. COTTON		12-17-98	SN
		CHKD: S. NAKANO			APVD
		APVD: D. HAMMA			
		ORIGINAL ISSUE			

8. PROTECT ALL MACHINED SURFACES DURING SHIPPING AND HANDLING.
 9. WELDS SHALL BE FULL STRENGTH OF PARENT MATERIAL PER STRUCTURAL WELDING CODE ANSI/AWS D1.1 (STEEL).
 10. ESTIMATED WEIGHT = 348 LBS.
11. FINISH: USE BLACK OXIDE PER MIL-C-13924A, CLASS 1, ON SPOOL INTERIOR. A DULL FINISH IS REQUIRED.



THIS DRAWING WAS CREATED BY THE UNIVERSITY OF CALIFORNIA THAT OPERATES LAWRENCE LIVERMORE NATIONAL LABORATORY FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. W-7405-ENG-48 ("LLNL"). ANY REPRODUCTION AND/OR FABRICATION IS PROHIBITED WITHOUT THE PERMISSION OF LLNL.

1	PLATE, 3.00" THK	STL A-36	3
1	PIPE, 17.00" OD X 1.50" WALL	STL A-36	2
1	PLATE, 3.00" THK	STL A-36	1
QUANTITY ABBREVIATIONS:			
NA = NO QUANTITY FOR DOCUMENTS	SHEET	1	
PM = PROCESS MATERIAL	ISSUE	00	
EM = EXPENSE MATERIAL	PART CLASSIFICATION	UNCLASSIFIED	
AR = AS REQUIRED	DRAWING CLASSIFICATION	UNCLASSIFIED	
AS = AS REQUIRED FOR ASSEMBLY	STATUS	LL-CHK	
ALT = ALTERNATE			
TITLE		(U) TITLE CLASSIFICATION	
OBOE/PIANO		OPTICAL PORTS	
OPTICAL HOUSING WELDMENT (U)		SIZE/DRAWING NUMBER	
AAA98-116025-00		E	
JO	COPY	CASEC 14067	SCALE 1/2
STATUS	LL-CHK	ORIGIN	LL-PRO/E-V19

DRAWING: 98-116025, MODEL: 98-116025, TYPE: ASSEM
GEOM PRN XX.XXX

UNCLASSIFIED

